
Supplement to Final Environmental Statement

related to construction and operation of
Clinch River Breeder Reactor Plant

Docket No. 50-537

U.S. Department of Energy
Tennessee Valley Authority
Project Management Corporation

Appendices

**U.S. Nuclear Regulatory
Commission**

Office of Nuclear Reactor Regulation

October 1982



APPENDIX A

COMMENTS ON THE DRAFT ENVIRONMENTAL STATEMENT

No changes have been made to this Appendix.

APPENDIX B

TENNESSEE WILDLIFE RESOURCES COMMISSION
PROCLAMATION
ENDANGERED OR THREATENED SPECIES

AND

U.S. DEPARTMENT OF THE INTERIOR
LETTER REGARDING
LISTED AND PROPOSED ENDANGERED
AND THREATENED SPECIES

TENNESSEE WILDLIFE RESOURCES COMMISSION
PROCLAMATION
ENDANGERED OR THREATENED SPECIES

Pursuant to the authority granted by Tennessee Code Annotated, Sections 51-905 and 51-907, the Tennessee Wildlife Resources Commission does hereby declare the following species to be endangered or threatened species subject to the regulations as herein provided. Said regulations shall become effective sixty days from this date.

SECTION I. ENDANGERED OR THREATENED SPECIES

MOLLUSCS

ENDANGERED

Birdwing pearly mussel	<i>Conradilla caelata</i>
Dromedary pearly mussel	<i>Dromus dromas</i>
Yellow-blossom pearly mussel	<i>Epioblasma</i> (-Dysnomia) <i>florentina</i>
	<i>florentina</i>
Green-blossom pearly mussel	<i>Epioblasma</i> (-Dysnomia) <i>torulosa</i>
	<i>gubernaculum</i>
Tuberculed-blossom pearly mussel	<i>Epioblasma</i> (-Dysnomia) <i>torulosa</i>
	<i>torulosa</i>
Turgid-blossom pearly mussel	<i>Epioblasma</i> (-Dysnomia) <i>turgidula</i>
Tan riffle shell pearly mussel	<i>Epioblasma</i> (-Dysnomia) <i>walkeri</i>
Fine-rayed pigtoe pearly mussel	<i>Fusconaia cuneolus</i>
Shiny pigtoe pearly mussel	<i>Fusconaia edgariana</i>
Pink mucket pearly mussel	<i>Lampsilis orbiculata orbiculata</i>
White warty-back pearly mussel	<i>Plethobasis cicatricosus</i>
Orange-footed pimpleback	<i>Plethobasis cooperianus</i>
Rough pigtoe pearly mussel	<i>Pleurobema plenum</i>
Cumberland monkeyface pearly mussel	<i>Quadrula intermedia</i>
Appalachian monkeyface pearly mussel	<i>Quadrula sparsa</i>
Pale lilliput pearly mussel	<i>Toxolasma</i> (-Carunculina) <i>cylindrella</i>
Painted snake coiled forest snail	<i>Anguispira picta</i>

FISH

ENDANGERED

Lake Sturgeon	<i>Acipenser fulvescens</i>
Ohio River Muskellunge	<i>Esox masquinongy ohioensis</i>
(in Morgan, Cumberland, Fentress & Scott Counties)	
Barren's Topminnow	<i>Fundulus</i> sp. (cf. <i>F. albolineatus</i>)
Spotfin Chub	<i>Hybopsis monacha</i>
Yellowfin Madtom	<i>Noturus flavipinnis</i>
Snail Darter	<i>Percina tanasi</i>

*Section I amended by Proc. No. 77-4
dated May 13, 1977, Proc. No. 78-14
dated Sept. 22, 1978; and, Proc. No. 78-20
dated Dec. 8, 1978.

Proc. No. 75-15*

SECTION I. (Continued)

FISH (Continued)THREATENED

Silverjaw Minnow
Slender Chub
Blue Sucker
Pigmy madtom
Frecklebelly Madtom
Slackwater Darter
Coldwater Darter
Trispot Darter
Duskytail Darter
Coppercheek Darter
Longhead Darter
Amber Darter
Reticulate Longperch

Ericymba bucatta
Hybopsis cahnii
Cycleptus elongatus
Noturus sp. (cf. *N. hilderbrandi*)
N. moritus
Etheostoma boschungii
E. ditrema
E. trisella
E. (Catonotus) sp.
E. sp. (cf. *E. maculatum*)
Percina macrocephala
P. (Imostoma) sp.
P. sp. (cf. *P. caprodes*)

AMPHIBIANSTHREATENED

Tennessee Cave Salamander

Gyrinophilus pallescens

REPTILESTHREATENED

Northern Pine Snake
Western Pigmy Rattlesnake

Pituophis m. melanoleucus
Sistrurus miliarius streckeri

BIRDSENDANGERED

Mississippi Kite
Golden Eagle
Bald Eagle
Osprey
Peregrine falcon
Red-cockaded Woodpecker
Raven
Bachman's Sparrow

Ictinia mississippiensis
Aquila chrysaetos
Haliaeetus leucocephalus
Pandion haliaetus
Falco peregrinus
Picoides borealis
Corvus corax
Aimophila aestivalis bachmanii

THREATENED

Sharp-shinned Hawk
Cooper's Hawk
Marsh Hawk
Bewick's Wren
Grasshopper Sparrow
Black-Crowned Night Heron

Accipiter striatus
A. cooperi
Circus cyaneus hudsonius
Thyromanes bewickii
Ammodramus savannarum
Nycticorax nycticorax

Proc. No. 75-15*

*Section I amended by Proc. No. 77-4
dated May 13, 1977; Proc. No. 78-14
dated Sept. 22, 1978; and, Proc. No. 78-20
dated Dec. 8, 1978.

SECTION I. (Continued)

MAMMALS

ENDANGERED

Eastern Cougar
Indiana Myotis
Gray Myotis

Felix concolor cougar
Myotis sodalis
Myotis grisescens

THREATENED

River Otter

Lutra canadensis

SECTION II. REGULATIONS

Except as provided for in Tennessee Code Annotated, Section 51-906 (d) and (e), it shall be unlawful for any person to take, harass, or destroy wildlife listed as threatened or endangered or otherwise to violate terms of Section 51-905 (c) or to destroy knowingly the habitat of such species without due consideration of alternatives for the welfare of the species listed in (1) of this proclamation, or (2) the United States list of Endangered fauna.

Date: June 12, 1975

Proc. No. 75-15*

*Section I amended by Proc. No. 77-4
dated May 13, 1977, Proc. No. 78-14
dated September 22, 1978; and, Proc. No. 78-20
dated Dec. 8, 1978.



United States Department of the Interior

FISH AND WILDLIFE SERVICE
PLATEAU BUILDING, ROOM A-5
50 SOUTH FRENCH BROAD AVENUE
ASHEVILLE, NORTH CAROLINA 28801

November 5, 1981



Mr. Paul S. Check
Director
CRBR Program Office
Office of Nuclear Reactor Regulation
Nuclear Regulatory Commission
Washington, DC 20555

Re: 4-2-82-047

Dear Mr. Check:

We have reviewed the proposed Clinch River Breeder Reactor Plant in Anderson County, Tennessee, as requested by letter of October 26, 1981, received October 29, 1981.

Federally listed Endangered (E) and/or Threatened (T) and/or species proposed for listing as Endangered (PE) or Threatened (PT) may occur in the area of influence of this action.

To facilitate compliance with Section 7(c) of the Endangered Species Act of 1973, as amended, Federal agencies or designated non-Federal representatives are required to obtain from the Fish and Wildlife Service information concerning the possible presence of any species, listed or proposed to be listed, which may be present in the impact area of a proposed major Federal action significantly affecting the quality of the human environment. Therefore, we are furnishing you the following list of species which may be present in the concerned area:

Gray bat (Myotis grisescens) - E
White warty-back pearly mussel (Plethobasis cicatricosus) - E
Dromedary pearly mussel (Dromus dromas) - E
Yellow-blossom pearly mussel (Epioblasma florentina florentina) - E
Fine-rayed pigtoe pearly mussel (Fusconaia cuneolus) - E
Shiny pigtoe pearly mussel (Fusconaia edgariana) - E
Pink mucket pearly mussel (Lampsilis orbiculata orbiculata) - E
Orange-footed pearly mussel (Plethobasis cooperianus) - E
Rough pigtoe pearly mussel (Pleurobema plenum) - E
Birdwing pearly mussel (Conradilla caelata) - E
Green-blossom pearly mussel (Epioblasma torulosa gubernaculum) - E
Alabama lamp pearly mussel (Lampsilis virescens) - E
Slender chub (Hybopsis cahni) - T

In addition to listed and proposed Endangered and Threatened species, there are species which, although not now listed or officially proposed for listing as Endangered or Threatened, are under status review (SR) by the Service and may be listed at some time in the future. Status review species

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are not legally protected under the Endangered Species Act and the biological assessment requirements do not apply to them. However, we would appreciate any efforts you might make to avoid adversely impacting them. The following species under status review may occur within the project area:

Cimicifuga rubifolia

Saxifraga careyana

Spiny River snail (Io fluvialis)

Section 7(c) and regulations being prepared to implement Section 7(c) also require the Federal agency or the designated non-Federal representative proposing a major Federal action to conduct and submit to the Service a biological assessment to determine the effects of the proposal on listed and proposed Endangered and Threatened species. The biological assessment shall be completed within 180 days after the date on which initiated or within a time frame mutually agreed upon between the agency and the Service and before initiating the proposed action. If the biological assessment is not begun within 90 days, this list must be verified informally (via phone) with us prior to initiation of your assessment. We do not feel that we can adequately assess the effects of the proposed action on listed and proposed Endangered and Threatened species or Critical Habitat without a complete assessment. When conducting a biological assessment, the Federal agency or the designated non-Federal representative must, at a minimum:

1. Conduct a scientifically sound on-site inspection of the area affected by the action, which must, unless otherwise directed by the Service, include a detailed survey of the area to determine if listed or proposed species are present or occur seasonally and whether suitable habitat exists within the area for either expanding the existing population or potential reintroduction of populations;
2. Interview recognized experts on the species at issue, including those within the Fish and Wildlife Service, the National Marine Fisheries Service, state conservation agencies, universities, and others who may have data not yet found in scientific literature;
3. Review literature and other scientific data to determine the species' distribution, habitat needs, and other biological requirements;
4. Review and analyze the effects of the action on the species, in terms of individuals and populations, including consideration of the cumulative effects of the action on the species and habitat;
5. Analyze alternative actions that may provide conservation measures;
6. Conduct any studies necessary to fulfill the requirements of (1) through (5) above;
7. Review any other relevant information.

Should you require additional information on this subject, please contact Mr. Gary Henry, Mr. Robert Currie, or Ms. Nora Murdock in the Asheville Area Office, FTS 672-0321, commercial 704/258-2850, ext. 321.

After the assessment has been completed and reviewed, it is the responsibility of the Federal agency to determine if the proposed action "may affect" any of the listed species or Critical Habitats or if it is likely to jeopardize the continued existence of proposed species or result in the destruction or adverse modification of any Critical Habitat proposed for such species. If the determination is "may affect" for listed species the Federal agency must request in writing formal consultation from this office. Requests for formal consultation must include: (1) a description of the action to be considered; (2) a description of the specific area that may be affected by the action; (3) a description of any listed species or Critical Habitat that may be affected by the action; (4) a description of the manner in which the action may affect any listed species or Critical Habitat and an assessment of any cumulative effects; (5) reports including any environmental impact statement, environmental assessment, or biological assessments prepared; and (6) any other relevant available information on the action, the affected listed species, or Critical Habitat.

In addition, if the proposed action is likely to jeopardize the continued existence of proposed Endangered or Threatened species or result in the destruction or adverse modification of proposed Critical Habitat, the Federal agency must confer with this office for assistance in identifying and resolving potential conflicts at an early stage in the planning process.

Attention is also directed to Section 7(d) of the Endangered Species Act, as amended, which underscores the requirement that the Federal agency and/or the permit or license applicant shall not make any irreversible or irretrievable commitment of resources during the consultation period which, in effect, would deny the formulation or implementation of reasonable alternatives regarding their actions on any listed Endangered or Threatened species.

If we can be of further assistance, please advise.

Sincerely yours,


William C. Hickling
Area Manager

cc:

Mr. Bob Hatcher, Wildlife Res. Agency, Nashville, TN
Program Administrator, TN Heritage Program, Nashville, TN
Director, FWS, Washington, DC (OES)
Regional Director, FWS, Atlanta, GA (ARD-FA/SE)
Field Supervisor, ES, FWS, Cookeville, TN



United States Department of the Interior

FISH AND WILDLIFE SERVICE
PLATEAU BUILDING, ROOM A-5
50 SOUTH FRENCH BROAD AVENUE
ASHEVILLE, NORTH CAROLINA 28801

September 17, 1982

Mr. Paul S. Check, Director
CRBR Program Office
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

RE: 4-2-82-047

Dear Mr. Check:

We have reviewed your biological assessment of the endangered species impacts of the proposed Clinch River Breeder Reactor dated August 1982 as requested by your letter of August 16, 1982, received August 19, 1982.

Your assessment addresses the potential impacts of the proposed project on the following species:

1. Gray bat - Myotis grisescens (E)
2. White wartyback pearly mussel - Plethobasus cicatricosus (E)
3. Dromedary pearly mussel - Dromus dromas (E)
4. Yellow-blossom pearly mussel - Epioblasma florentina florentina (E)
5. Fine-rayed pigtoe - Fusconaia cuneolus (E)
6. Shiny pigtoe - Fusconaia edgariana (E)
7. Pink mucket pearly mussel - Lampsilis orbiculata (E)
8. Orange-footed pearly mussel - Plethobasus cooperianus (E)
9. Rough pigtoe - Pleurobema plenum (E)
10. Birdwing pearly mussel - Conradilla caelata (E)
11. Green-blossom pearly mussel - Epioblasma torulosa gubernaculum (E)
12. Alabama lamp pearly mussel - Lampsilis virescens (E)
13. Slender chub - Hybopsis cahnii (T)

In addition to these federally listed species, your assessment also addresses three species which are not currently listed or proposed for listing by the Service. These species are:

1. Appalachian bugbane (cimicifuga rubifolia)
2. Carey's saxifrage (Saxifraga careyana)
3. Spiny river snail (Io fluvialis)

The distributional records maintained in this office indicate that these 16 species are the only federally listed, proposed, and status review species which may occur in the impact area of the Clinch River Breeder Reactor Project.

Based upon the information presented and referenced in your assessment, we concur with your conclusion that this project will have no effect (either beneficial or adverse) on the federally listed species described above. The assessment indicates that populations of the two status review plants listed above are known from the project site and that these populations will be protected from disturbance both during construction and operation of the proposed project. The assessment demonstrates that the project will have no effect on the other status review species (spiny river snail). In view of this we believe that the requirements of Section 7 of the Endangered Species Act of 1973, as amended have been satisfied. However, obligations under Section 7 of the Act must be reconsidered if (1) new information reveals impacts of this identified action that may affect listed species or Critical Habitat in a manner not previously considered, (2) this action is subsequently modified in a manner which was not considered in this biological assessment, or (3) a new species is listed or Critical Habitat determined that may be affected by the identified action.

Your interest and initiative in protecting Endangered and Threatened species is appreciated.

Sincerely yours,



V. Gary Henry
Acting Field Supervisor
Endangered Species

cc:
Director, FWS, Washington, DC (OES)
Director, FWS, Washington, DC (PAO, Attention: Meg Durham)
Regional Director, FWS, Atlanta, GA (SE)
Cookeville ES Office, FWS, Cookeville, TN

APPENDIX C

**ADDITIONAL CORRESPONDENCE REGARDING
ARCHEOLOGICAL AND HISTORICAL RESOURCES**



TENNESSEE DEPARTMENT OF CONSERVATION
TENNESSEE HISTORICAL COMMISSION
701 Broadway
Nashville, TN 37203
615/742-6716

May 17, 1982

Mr. Maxwell D. Ramsey
Program Manager, Cultural Resources
Division of Land and Forest Resources
Tennessee Valley Authority
Norris, Tennessee 37828

Re: Clinch River Breeder Reactor Project (CRBRP)-review of
recent archaeological, historical and architectural
identification studies

Dear Max:

The above reports were reviewed by the State Historic Preservation Officer and his staff with regard to compliance in federal historic preservation laws and regulations. Based on the information supplied and previous work in the CRBRP area, it is our opinion that the project as presently planned will not affect any properties included in or eligible for inclusion in the National Register of Historic Places.

No further action is required to comply with the National Historic Preservation Act unless project plans are changed or archaeological sites are discovered during construction.

Thank you for your continued cooperation.

Sincerely,

Herbert L. Harper
Executive Director and
Deputy State Historic
Preservation Officer

HLH:sd



TENNESSEE DEPARTMENT OF CONSERVATION
TENNESSEE HISTORICAL COMMISSION
701 Broadway
Nashville, TN 37203
615/742-6716

September 8, 1982

Maxwell D. Ramsey
Tennessee Valley Authority
Norris, Tennessee 37828

Re: Transmission Line, Clinch River Breeder Reactor
Plant, Oak Ridge, Tennessee

Dear Mr. Ramsey:

This letter is to confirm prior telephone conversations between your and my staff concerning the need for field survey of CRBRP transmission lines. Since the proposed line parallels an existing Bull Run-Sequoyah 500 KV line and the section on the Plant site has been examined, the effects will be limited to tower footing construction. Therefore a separate archaeological and historical field survey is not warranted. If during tower construction, archaeological materials are encountered our office should be informed.

No further action is required to comply with the National Historic Preservation Act for this phase of the CRBRP project.

Thank you for your cooperation.

Sincerely,

Herbert L. Harper,
Executive Director and
Deputy State Historic
Preservation Officer

HLH:jd

9/14/82--JBG:TDD

cc: Mr. Ken Yates
Public Safety Division
CRBRP/PO
Box U
55 Jefferson Circle
Oak Ridge, Tennessee 37830

APPENDIX D

ENVIRONMENTAL EFFECTS OF THE CRBR FUEL CYCLE AND TRANSPORTATION OF RADIOACTIVE MATERIALS

The material in this appendix replaced the material in Appendix D in the original issuance of the FES.

D.1 INTRODUCTION

In February 1977 the Nuclear Regulatory Commission (NRC) issued NUREG-0139 (NRC 1977a), "Final Environmental Statement Related to Construction and Operation of Clinch River Breeder Reactor Plant" (CRBRP). The environmental effects of the CRBR fuel cycle and of the transportation of radioactive materials between supporting facilities were considered in Appendix D of that document based upon the then-postulated future commercial facilities. The NRC Atomic Safety and Licensing Board admitted contentions of intervenors (Natural Resources Defense Council, et al.) relating to the alleged inadequacy of the Appendix D analysis to address environmental impacts of the specific CRBR fuel cycle, including location and mode of operation for the management of radioactive wastes. The analysis which follows addresses both new information and responds to the admitted contentions.

In the Appendix D analysis, the NRC staff considered the applicants' environmental analysis which was supplied in their Environmental Report on the CRBRP, as amended (AEC 1974a). As part of that analysis for fuel cycle impacts, the applicants relied on the Atomic Energy Commission (AEC) and Energy Research and Development Administration (ERDA) generic programmatic environmental impact statements for liquid metal fast breeder reactors, WASH-1535 (AEC 1974c) and ERDA-1535 (ERDA 1975a). That analysis assumed the availability of commercial-scale facilities to support a large-scale LMFBR fuel cycle and considered the total impacts of an entire breeder industry. The applicants estimated the impacts of the CRBR fuel cycle by prorating the impacts of a large breeder industry to the corresponding CRBR fuel cycle. The factor used represented that fraction of the total industrial LMFBR thermal power output to that attributable to CRBRP.

In the mid-1970s, the staff considered this method acceptable since commercial-scale reprocessing and recycle facilities were planned for the LWR fuel cycle and could be projected to be applicable to the CRBR fuel cycle. Accordingly, the staff followed this rationale to some extent in preparing the CRBRP Draft Environmental Impact Statement, which was issued in February 1976. However, in the CRBRP Final Environmental Statement (NRC 1977a), the staff relied to a large extent on information derived from its own staff work on generic fuel cycle models, such as those published in NUREG-0002, i.e., GESMO (NRC 1976a) and Table S-3 of 10 CFR 51. The staff also used environmental impact data it had developed for the Barnwell Nuclear Fuel Plant (NRC 1976b). These analyses depend, in large measure, upon the nearly 40-year experience that has been gained in reprocessing facilities used in government programs and currently operating under contract for the Department of Energy (DOE).

At the present time there appears to be little prospect of commercial operations which could support the CRBR fuel cycle requirements in the near future. Consequently, DOE (now the lead applicant) plans to undertake CRBRP supporting fuel cycle functions at its own facilities. The technology of processes and services for the fuel cycle remains essentially the same as originally perceived. The updated ER and this EIS address the proposed use of DOE facilities rather than commercial suppliers. Therefore, DOE has responded to the contentions on fuel cycle considerations by amending its Environmental Report with Amendment XIV (DOE 1982), which addresses the facilities now proposed by the DOE for use in the CRBR fuel cycle, and the environmental impacts of using those facilities. The staff has used Amendment XIV to the CRBR Environmental Report as a basis for performing an independent assessment of the environmental effects of the CRBR fuel cycle.

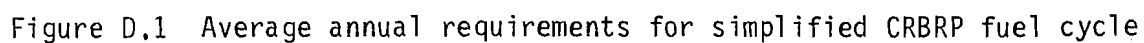
The simplified fuel cycle proposed by DOE for CRBRP equilibrium operation is represented in Figure D.1 and is considered by the staff as an example CRBR fuel cycle. The average annual CRBRP fuel requirements for the plant operation were developed from DOE CRBRP data bases (e.g., PSAR, ER, etc.) for the NRC staff by ORNL (NRC 1982a). The ORIGEN2 Program (Croff 1980) was used to produce this data output. The loading of the CRBRP includes segmented fuel assemblies containing active centers with mixed oxides of uranium and plutonium in the core portion and upper and lower axial blanket segments containing depleted uranium dioxide. Depleted uranium dioxide would also be used in the radial blanket fuel assemblies. The depleted uranium comes from the DOE operated gaseous diffusion plants. This uranium, containing a nominal 99.8% of U-238, will absorb neutrons and ultimately form Pu-239. The net production of plutonium in the reactor is expected to be positive (i.e., more plutonium is produced than undergoes fission).

According to information provided by DOE in its PSAR and ER, as summarized in this EIS, the composition of the initial loading of the CRBRP is described in Table D.1.

Table D.1 CRBR initial loading

Component	Quantity in initial loading (MT)	
	Uranium	Plutonium
Core Assemblies (156) ¹		
Active Middle Sections	3.48	1.71
Axial Blanket	4.22	
Radial and Inner Blanket Assemblies (208)	21.0	
TOTAL	28.7	1.71

¹The core assemblies consist of three segments: the active middle sections and upper and lower axial blankets sections.



The 208 radial and inner blanket assemblies will surround and be intermixed with the 156 core fuel assemblies as shown in Figure A3.4 in this FES. In equilibrium operations, on the average, as shown in Figure D.1, 81 core fuel assemblies and 69.2 blanket assemblies would be replaced annually.

The initial feed materials would consist of plutonium (obtained from DOE stockpiles) and depleted uranium (which is a by-product from the enrichment of the uranium-235 content of natural uranium). The plutonium would be converted to plutonium dioxide at a reprocessing plant while the uranium as the hexafluoride would be converted to uranium dioxide at a commercial fuel fabrication plant. Subsequently, at a mixed-oxide fuel fabrication plant, plutonium dioxide and uranium dioxide would be blended and fabricated into mixed-oxide fuel for the active middle segments of the core fuel assemblies. Uranium dioxide would be fabricated into pellets for the upper and lower axial blanket portion of the core fuel assemblies, and for radial and inner blanket assemblies of the reactor.

After exposure to neutron fluxes in the reactor, the irradiated core fuel assemblies and blanket assemblies would be stored at the reactor for a specified time. During this period the shorter-lived fission products would decay and reduce the assemblies' decay-heat generation rates. Subsequently, the irradiated core and blanket assemblies would be shipped in shielded casks to a reprocessing plant where the plutonium and uranium would be separated from each other and from fission products and other actinides using chemical processes. The high-level liquid waste stream containing the separated fission products and other transuranic elements would be solidified in an acceptable form and shipped to a Federal waste-storage facility. In the recycle mode of operations the plutonium would be shipped to the mixed-oxide fuel fabrication plant for recycle as fuel. The recovered uranium would either be stored for later disposition or recycled into the mixed oxide or blanket fuel assemblies. Depleted uranium from enrichment facilities would be used as necessary to make up for the uranium that would be converted to plutonium in the reactor or lost as scrap or waste in the fuel cycle process steps.

A conservative analysis of the predicted environmental impact from the DOE-provided fuel cycle associated with the CRBRP and the transport of radioactive materials between the supporting facilities is presented in this appendix. This analysis is based on the quantities of materials projected by DOE to be required in its simplified fuel cycle to maintain the CRBRP operation and is summarized in Figure D.1. The physical characteristics and detailed description of the reactor fuel assemblies and fuel regions developed from DOE information are shown in Tables D.2 and D.3. The quantities and characteristics of materials and the material shipments for the CRBRP fuel cycle might be somewhat different during various phases of CRBRP operations. However, quantities of radionuclides and irradiation (i.e., burnup) of assemblies and their radioactivity level would be essentially similar to the levels assessed by DOE for the mode of CRBRP operation in the ER and to the levels used by the staff for its detailed assessments. Therefore, the staff has based its detailed evaluation on the simplified fuel cycle and the mode of CRBRP operation as provided by DOE, with burnups shown in Table D.3 and as calculated in NRC 1982a.

Table D.2 Physical characteristics of CRBRP fuel assemblies*

	Core & axial blanket	Inner & radial blankets
Assembly component lengths, cm		
Upper end hardware	30.4	30.4
Gas plenum	124.5	124.5
Upper axial blanket	35.6	
Core or radial blanket	91.4	162.6
Lower axial blanket	35.6	
Lower end hardware	109.2	109.2
Overall total	426.7	426.7
Fuel element total	290.6	291.5
Assembly shape	hexagonal	hexagonal
Assembly flats, cm	11.62	11.62
Fuel element arrangement	triangular	triangular
Fuel elements per assembly	217.0	61.0
Fuel element OD, cm	0.584	1.285
Fuel pellet OD, cm		
Core	0.491	
Axial blanket	0.483	
Inner and radial blanket		1.194
Fuel pellet density, % of theoretical		
Core	91.3	
Axial blanket	96.0	
Inner and radial blanket		95.6
Fuel element pitch, cm	0.731	1.378
Cladding thickness, cm	0.038	0.038
Channel thickness, cm	0.305	0.305
Channel height, cm	314.0	314.0
Circumscribed volume/assembly, cm	0.0607	0.0607
Heavy metal/assembly, kg	60.35	100.85
Heavy metal oxide/assembly, kg**	68.45	114.39
Stainless steel/assembly, kg	135.5	122.6
Assembly total weight, kg	204.0	237.0

* NRC 1982a.

** (Pu,U) dioxide in the core with uranium oxide in the axial blanket and in the inner and radial blankets.

Table D.3 Summary characteristics for CRBR (a)

Parameter	Fuel Region(s) (b)					
	Fuel	AB	Fuel + AB	IB	RB (c)	Fuel + AB + IB + RB
Electric power, MW(e) net	267.4	6.1	273.5	46.9	29.6	350.0
Thermal power, MW(t)	745.0	17.0	762.0	130.5	82.5	975.0
Average specific power, (d) MW(t)/MTIHM (e)	140.9	3.95	79.4	16.4	6.49	32.21
Average fuel burnup, MWd/MTIHM	76,031	2,133	42,870	8,693	7,977	22,600
Effective irradiation duration, full-power days	540	540	540	530	1,229	
Refueling cycle length, full- power days	275	275	275	275	275	275
Average number of assemblies charged per cycle	81	81	81	41	28.2	
Average charge, kg/refueling cycle (f)						
U-235	3.6	4.4	8.0	8.3	5.7	22.0
Total uranium	1,805.5	2,193.5	3,999.0	4,134.9	2,843.9	10,978
Fissile plutonium (g)	783.0	0	783.0	0	0	783.0
Total plutonium	889.4	0	889.4	0	0	889.4
Total (U + Pu)	2,694.9	2,193.5	4,888.4	4,134.9	2,843.9	11,867
Average discharge, kg/refueling cycle (f)						
U-235	2.6	3.6	6.2	5.9	4.0	16.1
Total uranium	1,715.8	2,149.0	3,864.8	3,960.2	2,726.9	10,552
Fissile plutonium (g)	627.2	38.5	665.7	131.6	89.1	886.4
Total plutonium	766.7	39.6	806.3	138.3	94.9	1,039.5
Total (U + Pu)	2,482.5	2,188.6	4,671.1	4,098.5	2,821.8	11,591

(a) NRC 1982a.

(b) Fuel = 36 inch (Pu,U) dioxide region, AB = uranium dioxide axial blankets associated with fuel, IB = entire inner blanket, RB = entire radial blanket.

(c) Weighted average of inner radial blanket (4 cycle residence) and outer radial blanket (5 cycle residence).

(d) Based on rated power level.

(e) MW(t)/MTIHM - Megawatt thermal per Metric Ton Initial Heavy Metal.

(f) Averaged over 4 cycles.

(g) Pu-239 + Pu-241 + Np-239.

In order to address options in fuel cycle operations that have the potential to affect radiological impacts, the staff has performed a qualitative sensitivity analysis of the simplified fuel cycle provided by DOE for CRBRP operations (see Section D.2.4.7).

D.2 ENVIRONMENTAL CONSIDERATIONS

The following sections evaluate the environmental effects from the overall CRBR fuel cycle, including releases from each processing step (Section D.2.1), waste management (Section D.2.2), and the transportation steps (Section D.2.3). A summary of effects of these operations is presented in Table D.4.

D.2.1 Fuel Cycle Impacts

The fuel cycle operations, as shown in Figure D.1, would include (1) fuel fabrication operations at two different facilities, a commercial fuel fabrication plant (for blanket assemblies and for producing the uranium dioxide for core assemblies) and a government-owned mixed oxide facility (for core fuel assemblies); (2) reprocessing operations at a government-owned reprocessing facility (there are currently no commercial reprocessing plants available in the United States for processing CRBRP spent fuels, and the staff is unable to project when or whether such facilities would be available for handling the spent fuels in the time frame of interest for the CRBRP); and (3) conversion of recovered plutonium and possibly uranium from nitrate solutions to fuel-grade plutonium dioxide and uranium dioxide, also at a government-owned reprocessing facility.

There are no requirements for the front end uranium steps of mining, milling, conversion, and enrichment to be charged to the CRBR fuel cycle, since these operations have already been incurred as a result of other fuel cycles, i.e., defense programs and/or commercial fuel cycles such as those supporting LWRs. Accordingly there are no environmental effects from such operations attributable to the CRBR fuel cycle.

D.2.1.1 Blanket Fuel Assemblies

Depleted uranium dioxide for both blanket and core fuel assemblies would be obtained by converting uranium hexafluoride from the enrichment tailing stockpiles associated with DOE gaseous diffusion enrichment plants.

DOE proposes that the fabrication of blanket fuel assemblies, which would include the conversion of depleted uranium hexafluoride to uranium dioxide for both blanket and core fuels, would be carried out in existing commercial facilities. The specific facility for the conversion has not yet been selected. However, environmental considerations for this portion of the CRBR fuel cycle can be projected from similar operations for the LWR uranium fuel cycle. Therefore, most of these in Table D.4 were obtained by multiplying the impacts of the model fuel fabrication plant as reported in Column E, Table S-3A of WASH-1248 (AEC 1974b) by a factor of about one-third. This factor is the ratio of 11.1 MTU, annual fuel requirement for CRBRP, to 35 MTU, model annual fuel requirement for an LWR. In addition, this approach overestimates the release of U-235 (and, hence, the consequence radiological impact), since the releases for these nuclides reported in WASH-1248 are based on the processing of low enriched uranium for LWRs, while depleted uranium is used for the CRBRP.

Table D.4 Summary of environmental considerations for the CRBRP fuel cycle annual requirements

	Fuel Fabrication		Reprocessing	Waste Management(a)	Transportation	Total
	Uranium Dioxide (Blanket)	Mixed Oxide (Core Fuel)				
<u>Natural Resource Use</u>						
<u>Land (ha)</u>						
Temporarily committed	0.02	-	36	0.08	-	36
Undisturbed area	0.02	-	32	-	-	32
Disturbed area	0.004	-	4	0.08	-	4
Permanently committed	-	-	-	0.05	-	0.05
Total land	0.02	-	36	0.13	- (b)	36
<u>Water (millions of gal)</u>						
Discharge to air	-	-	9.6		-	9.6
Discharged to water bodies	1.6	0.3	5.1		-	7.0
Total water	1.6	0.3	14.7	0.2 (c)	-	17
<u>Fossil Fuel</u>						
Elect. energy (MJ)	1.9E+6	3.2E+7	4.1E+7	3.1E+6	-	7.8E+7
Equivalent coal (MT)	2.0E+2	3.6E+3	8.0E+3	4.7E+2	(d)	1.2E+4
<u>Effluents-Chemicals (MT)</u>						
<u>Atmospheric (e)</u>						
Sulfur Oxides	7.	130.	280.	21 (f)	1.1	440.
Nitrogen Oxides	2.	35.	80.	12	15.4	140.
Hydrocarbons	0.02	0.4	0.8	0.7	1.5	3.4
Carbon Monoxide	0.05	0.9	2.	23	9.4	35
Particulates	2.	35.	80.	4.9	0.5	120
Fluoride	0.006 (g)	-	-	-	-	0.006
Ammonia	6.7 (g)	-	-	-	-	6.7
<u>Liquid</u>						
Nitrate	7.3	-	-	-	-	7.3
Ammonia	3.2	-	-	-	-	3.2
Fluoride	1.3	-	-	-	-	1.3
<u>Solids</u>						
Calcium fluoride	11. (h)	-	-	-	-	11.00
Water treatment sludge	-	-	800.	-	-	800.

Table D.4 (Continued)

	Fuel Fabrication		Reprocessing	Waste Management(a)	Transportation	Total
	Uranium Dioxide (Blanket)	Mixed Oxide (Core Fuel)				
<u>Effluents - Radiological (Ci)</u>						
<u>Atmospheric</u>						
U-235	8E-7	7.0E-13	7.8E-11	- (b)	-	8E-7
U-238	6E-5	5.4E-11	7.4E-9	-	-	6E-5
Pu-236	-	4.5E-10	3.3E-9	-	-	3.8E-9
Pu-238	-	9.6E-7	8.5E-5	-	-	8.6E-5
Pu-239	-	5.9E-7	2.7E-5	-	-	2.8E-5
Pu-240	-	4.9E-7	2.2E-5	-	-	2.2E-5
Pu-241	-	6.7E-5	2.6E-3	-	-	2.7E-3
Pu-242	-	6.7E-10	4.7E-8	-	-	4.8E-8
Am-241	-	7.9E-8	2.1E-5	-	-	2.1E-5
H-3	-	-	5.9E+3	-	-	5.9E+3
C-14	-	-	1.4E+1	-	-	1.4E+1
Kr-85	-	-	5.1E+3	-	-	5.1E+3
I-129	-	-	3.7E-4	-	-	3.7E-4
I-131	-	-	3.9E-2	-	-	3.9E-2
Ru-103	-	-	2.9E-2	-	-	2.9E-2
Ru-106	-	-	1.2E-1	-	-	1.2E-1
Cs-134	-	-	7.6E-5	-	-	7.6E-5
Cs-137	-	-	1.7E-4	-	-	1.7E-4
Particulate FP	-	-	6.5E-3	-	-	6.5E-3
Radon and decay products	-	-	-	0.5	-	0.5
<u>Liquid</u>						
U-235	8E-5	-	-	- (b)	-	8E-5
U-238	6E-3	-	-	-	-	6E-3
<u>Thermal (MJ)</u>	3.2E+6	1.0E+8	2.2E+8	2.8E+5	2.1E+5 (i)	3.2E+8

(a) Upper value of range which depends upon geology chosen See Table D.13. Lifetime impacts prorated to annual requirements.

(b) - means not reported, or the staff believes these values would negligible by comparison be to other releases reported under waste management. For waste management this footnote applies to all radiological effluents except radon and decay products.

(c) Water consumed in repository construction.

(d) 92,000 gallons of diesel fuel would be used in transport

(e) Based upon combustion of equivalent coal for power generation or of fuel for machinery.

(f) Chemical effluents from waste management operations include estimates of releases from operation of machinery during construction of the repository (see Table D.11) and from the burning of equivalent coal to produce the electrical energy.

(g) Based on NRC 1977b.

(h) Calcium fluoride is isolated in settling ponds from liquid effluent.

(i) Based on heat load of major contributors (spent fuel, blanket and HLW).

D.2.1.2 Core Fuel Assemblies

There are currently no commercially operated facilities producing fuel assemblies containing mixed oxides (uranium dioxide-plutonium dioxide). DOE proposes that the Secure Automated Fabrication (SAF) line to be built in the Fuel and Materials Examination Facility (FMEF) on the Hanford Reservation would be used for making mixed-oxide fuel materials and core fuel rods. The uranium dioxide in powder form would be received from the commercial uranium dioxide fuel fabrication plant that produces the blanket assemblies. The plutonium dioxide in powder form would be received from DOE stockpiles or from plutonium conversion facilities at a reprocessing plant. The uranium and plutonium oxide powders would be blended, formed, and sintered into mixed-oxide pellets for core fuel in the SAF line. The axial blanket uranium dioxide pellets would be included in the upper and lower segments of the core fuel rods in the SAF line. After the core fuel rods are loaded, sealed, and externally decontaminated they would be fabricated into core fuel assemblies in the Fuels Development Laboratory (Building 308), located approximately 13 km from the FMEF.

DOE completed an environmental assessment of the FMEF (DOE 1980a), and it was supplemented to include impacts resulting from the addition of the SAF line (DOE 1981b). Based on these assessments, DOE estimated resource requirements and effluent releases relating to mixed-oxide core rod fabrication for the CRBRP. In Amendment XIV of its Environmental Report, DOE included its analysis in Table 5.7-1, which summarizes the environmental considerations for CRBR fuel cycle. The staff considers these data acceptable for an environmental assessment since, in its views, the quantities are overestimated, and therefore conservative, because (1) DOE used data relating to the whole of FMEF, of which SAF line requirements and releases are only a part, (2) comparisons with staff assessments made for GESMO (NRC 1976a) show requirements and releases per ton of mixed-oxide fuel substantially lower than those in Amendment XIV. The staff also finds acceptable DOE's assessment of natural resources uses and thermal releases for core fabrication as follows:

- o land use is insignificant since the SAF line and Building 308 are on existing government properties located in areas devoted to other activities,
- o water use is $2.0\text{E}+5$ gallons per year (750 gal per day at 72% overall time efficiency),
- o thermal releases are $1.0\text{E}+8$ MJ/yr ($9.5\text{E}+10$ BTU/yr).

For its assessment of radiological effluents the staff took a more realistic approach to estimating radioactive releases from the SAF line by using the throughput required in support of the CRBRP as follows.

The annual process throughput capability for the SAF line would be 4 MTPu. The annual fuel requirement for the CRBRP (see Figure D.1) would be 0.889 MTPu. The staff assumed a nominal plutonium composition of plutonium-240 content of 12 wt%, and aged approximately 2 years before fabrication into core assemblies. During this period, plutonium-241 decays with a 14.7 year half-life to americium-241. The composition of the plutonium assumed by DOE in its calculations was a nominal 20 wt% plutonium-240, unaged. The isotopic composition of

the feed plutonium to the SAF line projected by NRC and DOE is listed in Table D.5.

Exhaust gases from the SAF line would pass through a series of three high-efficiency particulate absolute (HEPA) filters. HEPA filters are required to have an efficiency of at least 99.95% each (ERDA/RL 1976). Three HEPA filters in series would therefore have a theoretical minimum overall efficiency of removing all but 1.25×10^{-10} of particulates reaching the filter bank. The DOE assessment conservatively used a cleanup factor of 1.25×10^{-8} (two orders lower than theoretical), and the staff finds this to be an acceptably conservative approach.

The radionuclides projected to be released annually to the atmosphere from the SAF line in support of the CRBRP fuel cycle are shown in Table D.6. The releases projected by DOE for the total SAF line operation (DOE 1981b) have been adjusted downward by the staff from the full capacity of 4 MTPu/year to the 0.889 MTPu annual throughput required for CRBRP.

Table D.5 Isotopic composition of feed to SAF line

Radionuclide	Assumed by NRC staff, wt% (NRC 1982a)	Assumed by DOE, wt% (DOE 1980a)
Pu-236	6.1×10^{-7}	8.0×10^{-6}
Pu-238	6.0×10^{-2}	5.0×10^{-1}
Pu-239	8.6×10^1	7.2×10^1
Pu-240	1.2×10^1	2.0×10^1
Pu-241	1.7×10^0	6.0×10^0
Pu-242	2.0×10^{-1}	1.5×10^0
Am-241	3.5×10^{-1}	(not reported)

Table D.6 Annual releases of plutonium from the SAF line in support of the CRBRP

Radionuclide	NRC staff estimate (Ci/yr)	DOE estimate (Ci/yr)*
Pu-236	9.3×10^{-11}	4.5×10^{-10}
Pu-238	1.2×10^{-7}	9.6×10^{-7}
Pu-239	5.9×10^{-7}	4.9×10^{-7}
Pu-240	3.0×10^{-7}	4.9×10^{-7}
Pu-241	2.2×10^{-5}	6.7×10^{-5}
Pu-242	8.7×10^{-11}	6.7×10^{-10}
Am-241	7.9×10^{-8}	(not reported)

*Adjusted to 0.889 MTPu throughput.

Based upon this analysis, the staff used the higher values from Table D.6 for each isotope in its assessment (Table D.4).

Using essentially the same bases, DOE calculated that releases of uranium isotopes from the SAF line processing 6 MTU/yr (maximum capacity) would be $1.1\text{E}-10$ Ci/yr. The staff considers this quantity to be a conservative estimate with regard to both quantity and radionuclides of concern since the DOE calculation is based on natural uranium. Depleted uranium to be used in the CRBRP contains only 0.2 wt% uranium-235 (versus 0.72 wt% for natural uranium) and essentially no uranium-234. Adjusting for these differences the staff estimates annual uranium atmospheric releases as $7.0\text{E}-13$ Ci of uranium-235 and $5.4\text{E}-11$ Ci of uranium-238.

DOE conservatively calculated doses from the SAF line by attributing all releases from the FMEF to the CRBRP core fabrication. This calculation is conservative (overestimated) in that only about 15 months SAF line operation in each 2-year period would be devoted to CRBRP fuel fabrication. Thus, an average annual dose attributable to uranium releases would be approximately 65% of that attributed to the SAF line at full capacity, and the annual dose attributable to plutonium releases would be roughly one-fourth of that attributed to the SAF line at full capacity.

Since the core fuel rods would be sealed, welded, tested, and externally decontaminated after fabrication at the SAF line and prior to shipment to the Fuels Development Laboratory (Building 308), no releases are expected from Building 308 due to the assembly of CRBRP core assemblies.

D.2.1.3 Fuel Reprocessing

Both core and blanket fuel assemblies would be removed from the CRBRP transported to the reprocessing plant and would be processed to separate uranium and plutonium from each other and from the fission products formed in the fuel during CRBRP operation. Recovered uranium as a uranyl nitrate solution would be calcined to uranium trioxide and stored for recycle or alternative future uses. Recovered plutonium nitrate solutions would be processed to produce plutonium dioxide, most of which may be used to produce replacement core fuel rods at the SAF line in the FMEF. Any excess Pu would be stored for future use.

D.2.1.3.1 Developmental Reprocessing Plant (DRP)

As a basis for evaluating the environmental impacts of the reprocessing step of the CRBR fuel cycle, DOE used the proposed DRP which has been under development since about 1977. This plant is still in the formative stages and is represented by preliminary design concepts (DOE 1981a).

According to the Conceptual Design Report (DOE, 1981a), the facility would have a capability of processing 150 MTHM/yr (0.5 MTHM/day). The reference site for the facility would be near the proposed site of the CRBRP near Oak Ridge, Tennessee. DOE states in Amendment XIV to its Environmental Report that reprocessing of LMFBR-type fuels would be supplemented by reprocessing of LWR fuels in the DRP. Since, however, the major purpose of the DRP is the reprocessing of LMFBR fuels, of which the CRBR fuels are the only ones known to the

staff, for the purposes of this supplement the staff has allocated the total land requirement for the DRP to the CRBR fuel cycle. Ninety acres (36 ha) are included in the reference site. The staff assumes that approximately 10 acres (4 ha) would be disturbed by the construction of facilities, roads, parking lots, etc.

However, consumable utilities and services have been allocated on a basis of plant throughput of fuels processed. For the purposes of this supplement to the environmental report, the staff has charged about 8% (11.86 MTHM of CRBRP spent fuels, compared to 150 MTHM/yr capacity of the DRP) of the consumable utility and services requirements to the CRBR fuel cycle.

Normal power supply to the DRP would be 20 MVA (equivalent to $5.2E+8$ MJ per 300-day year at full power). Standby power supply of 8000 kW would be provided. Emergency diesel oil storage would be 30,000 gallons, the quantity required for seven days of uninterrupted operation. Process steam would be provided by two coal-fired boilers, each sized to deliver 75,000 lb/hr of saturated steam at 350 psig, and each consuming 3.5 tons/hr of coal. Normal cooling water would be supplied by using two of three pumps, each rated at 14,500 gpm at 150-ft head, driven by 700-HP electric motors. Other requirements would include emergency cooling water, demineralized water, sanitary water, compressed air, and instrumentation. Non-contaminated waste water treatment would be 202,000 gpd of cooling tower blowdown, 20,000 gpd of boiler blowdown, 7000 gpd of laboratory drainage, and 10,000 gpd of regenerate/rinse solutions. Treatment of this waste would produce 25,000 gpd of sludges (equivalent to roughly 10,000 MT of solids per year, assuming the fraction of solids in the sludge is 0.25) to be disposed off site and 215,000 gpd ($6.5E+7$ gallons per year for 300-day-per-year operation) for disposal in an effluent pond. The staff assumes cooling tower evaporation would be twice the cooling tower blowdown ($1.2E+8$ gallons per year).

On the bases indicated above, annual water use in support of reprocessing CRBR spent fuel would be 5.1 million gallons of water discharged to water bodies and 9.6 million gallons discharged to air. Electrical energy use would be $4.1E+7$ MJ. Water treatment sludge produced from processing CRBR fuels would be about 800 MT/yr.

Independent data on the radionuclide content of CRBRP spent fuel were developed by ORNL (NRC 1982a) using the ORIGEN2 code (Croff, 1980). Major assumptions and parameters used by the staff in the development of data on radionuclide content of spent fuel, and comments comparing those data with data used by DOE as reported in Amendment XIV of its Environmental Report, follow:

- o Plutonium used in the core fuel was assumed by the staff to be nominally 12% Pu-240. The NRC staff understands that 12% Pu-240 is the likely candidate for CRBRP fuel. DOE, however, assumed 20% Pu-240 in the calculations reported in its Amendment XIV.
- o The plutonium was assumed by the staff to be aged a total of 4 years after separation (2 years prior to core fuel fabrication and another 2 years prior to charging to the CRBRP). Thus, americium-241 was present in the new fuel as a decay product of plutonium-241.

- o The uranium to be used with the plutonium in the core and in the blanket fuels was assumed by the staff to be enrichment tails with 0.2% U-235. DOE assumed natural uranium with 0.72% U-235 in its calculations.

As a result of the differing assumptions on the nuclide distribution in the fuels, the contents of spent fuel as calculated by ORNL differ somewhat from the DOE calculations. The results are compared in Table D.7. Minor differences

Table D.7 Comparison of CRBRP spent fuel data*
contained radioactivity, Ci/yr

Nuclide	NRC-ORIGEN2	DOE-Am. XIV, Table 5.7-3
H-3	5.9E+03	5.51E+03
C-14	8.3	1.44E+01
Kr-85	5.1E+04	4.75E+04
Sr-90	3.2E+05	3.70E+05
I-129	3.7E-01	3.26E-01
I-131	3.9E+01	3.61E+01
Ru-103	1.9E+06	1.84E+06
Ru-106	8.0E+06	7.09E+06
U-232	1.9E-01	3.11E-02
U-234	1.6E-01	8.12E-01
U-235	3.5E-02	3.92E-02
U-236	9.4E-02	7.91E-02
U-238	3.5	3.68
Pu-236	6.6	3.07
Pu-238	1.6E+04	1.69E+05
Pu-239	5.4E+04	4.27E+04
Pu-240	3.4E+04	4.40E+04
Pu-241	1.7E+06	5.10E+06
Pu-242	1.0E+01	9.40E+01
Cs-134	3.8E+05	2.80E+05
Cs-137	8.3E+05	7.99E+05
Th-228	1.2E-01	5.98E-03
Th-231	3.5E-02	3.92E-02
Th-234	3.5	3.68
Am-241	1.2E+04	1.03E+05
Np-237	8.7E-01	1.04
Pa-234	3.5	3.68
Cm-242	3.7E+05	2.71E+06
Cm-244	7.0E+02	3.58E+03

*150 days after reactor discharge.

are noted in the fission product distributions. Somewhat more significant differences are noted in some of the actinide components, principally because of the different isotopic composition of plutonium and of the growth of americium-241. However on the basis of radioactivity, thermal power and ingestion toxicity, CRBR spent fuel is very much like PWR spent fuel from discharge to about 100 years after discharge and increases by about one order of magnitude in these properties after that time (NRC 1982a).

Assumptions used by ORNL (NRC 1982a) in calculating the radionuclide content of high-level waste (HLW) obtained as a result of reprocessing the spent fuel include:

- o 0.5% of the uranium and plutonium are not recovered by reprocessing and are lost to the HLW.
- o 0.05% of non-volatile fuel material is retained with the cladding.
- o 0.69% of the fuel assembly structural material is assumed to dissolve and go to the HLW.
- o 0.1% of the halogen elements and none of the noble gases, tritium, and carbon-14 is assumed to be in the HLW.

These assumptions are consistent with those used by DOE in the development of HLW data reported in Amendment XIV of its Environmental Report.

Atmospheric releases from the DRP have been projected by the staff, using data from the ORIGEN2 codes (NRC 1982a) and the confinement factors for all radionuclides proposed by DOE, except for ruthenium isotopes. For the ruthenium isotopes, the staff chose the more conservative release factors reported by DOE in its technical support document for the management of commercial radioactive wastes (DOE 1979). The results of these estimates are summarized in Table D.8 and included in Table D.4 as Column 4. The staff believes that the estimated releases reported in the last column of Table D.8 will be achievable by any of the potential alternatives for the DRP that are discussed below. This view is consistent with that expressed by DOE in Amendment XIV.

The DRP or the model FRP would convert liquid HLW to solids such as borosilicate glass. The solid HLW would be sealed in canisters and shipped to either storage or disposal.

D.2.1.3.2 Alternative Reprocessing Plants

DOE is considering alternatives to the DRP for reprocessing of the fuel. One alternative would be the licensed operation of such a facility by private industry which would have to meet NRC requirements. Other alternatives being considered are (1) the modification of existing DOE reprocessing facilities at Hanford or Savannah River and (2) construction of new DOE facilities. In any instance, offsite environmental impacts ascribed to atmospheric releases from these alternatives are considered by the staff to be enveloped by the impacts

Table D.8 Source term selection for dose calculation reprocessing releases from CRBR fuel cycle

Nuclide	Source Term (Ci/yr)		
	NRC-ORIGEN2 Basis(a)	DOE-Amend. XIV	NRC-Selected(b) (c)
H-3	5.9E+03	5.5E+03	5.9E+03
C-14	8.3	1.4E+01	1.4E+01
Kr-85	5.1E+03	4.8E+03	5.1E+03
Sr-89	2.0E-04	--	2.0E-04
Sr-90	6.3E-05	7.4E-05	7.4E-05
Y-90	6.3E-05	--	7.4E-05
Y-91	3.6E-04	--	3.6E-04
Zr-95	7.6E-04	--	7.6E-04
Nb-95	1.4E-03	--	1.4E-03
Ru-103	2.9E-02	1.8E-03	2.9E-02
Rh-103m	2.6E-02	--	2.6E-02
Ru-106	1.2E-01	7.1E-03	1.2E-01
Rh-106	1.2E-01	--	1.2E-01
Sb-125	4.9E-05	--	4.9E-05
Te-125m	1.2E-05	--	1.2E-05
Te-127	2.4E-05	--	2.4E-05
Te-127m	2.4E-05	--	2.4E-05
I-129	3.7E-04	3.3E-04	3.7E-04
I-131	3.9E-02	3.6E-02	3.9E-02
Cs-134	7.6E-05	5.6E-05	7.6E-05
Cs-137	1.7E-04	1.6E-04	1.7E-04
Ba-137m	1.6E-04	--	1.6E-04
Ce-141	1.8E-04	--	1.8E-04
Ce-144	1.5E-03	--	1.5E-03
Pr-144	1.5E-03	--	1.5E-03
Pr-144m	1.8E-05	--	1.8E-05
Pm-147	4.1E-04	--	4.1E-04
Pm-148m	1.9E-05	--	1.9E-05
Sm-151	6.4E-06	--	6.4E-06
Eu-154	5.2E-06	--	5.2E-06
Eu-155	2.5E-05	--	2.5E-05
U-232	3.9E-10	6.2E-11	3.9E-10
U-234	3.1E-10	1.6E-09	1.6E-09
U-235	7.0E-11	7.8E-11	7.8E-11
U-236	1.9E-10	1.6E-10	1.9E-10
U-237	8.4E-08	--	8.4E-08
U-238	7.1E-09	7.4E-09	7.4E-09
Pu-236	3.3E-09	1.5E-09	3.3E-09
Pu-238	8.1E-06	8.5E-05	8.5E-05
Pu-239	2.7E-05	2.1E-05	2.7E-05
Pu-240	1.7E-05	2.2E-05	2.2E-05
Pu-241	8.5E-04	2.6E-03	2.6E-03
Pu-242	5.2E-09	4.7E-08	4.7E-08
Am-241	2.5E-06	2.1E-05	2.1E-05
Am-242m	2.3E-07	--	2.3E-07
Cm-242	7.5E-05	5.4E-04	5.4E-04
Cm-243	3.3E-08	--	3.3E-08
Cm-244	1.4E-07	7.2E-07	7.2E-07
Np-237	1.7E-10	2.1E-10	2.1E-10
Pa-234	7.0E-10	7.4E-10	7.4E-10
Th-228	2.4E-11	1.2E-12	2.4E-11
Th-231	7.0E-12	7.8E-12	7.8E-12
Th-234	7.0E-10	7.4E-10	7.4E-10

- (a) These calculated source terms use the ORIGEN2, Basis (NRC 1982a) for isotope composition in spent fuel. Amendment XIV (DOE 1982) confinement factors were used except for ruthenium (and their daughters) for which the release factor of the Data Sheet No. 25b of DOE/ET-0028 (DOE 1979) was used since these release factors appear to be more realistic for the near term and were more conservative, i.e., larger.
- (b) The highest source term from the two approaches was chosen. The ORIGEN2 data were used where there were none reported in Amendment XIV. This approach is the most conservative in that it gives the highest releases, thereby bounding the expected routine releases.
- (c) Some isotopic values based on radiological equilibrium values.

estimated for the DRP. In Amendment XIV DOE provides the philosophy upon which the DRP design is based. The staff understands that these design parameters would be applied to any of these DOE alternatives in the event that one is selected instead of the DRP for reprocessing CRBRP fuel.

The staff notes that neither the DRP nor the model reprocessing plants assumed by DOE for reprocessing would release any liquid radioactive wastes to the environment. If the alternative of using existing DOE facilities were selected, both the Hanford and Savannah River plants release very low levels of radioactivity in liquids to the environs (ERDA 1975b; ERDA 1977). The impacts of all releases from these plants, including atmospheric releases and liquid releases, have been very small as indicated in the referenced documents. Accordingly, and since the radionuclide throughput of CRBRP fuels would be not more than approximately 25%* of the throughput for processing other fuels, the impact of liquid low-level releases would be a fraction of these small releases.

Neither the Hanford nor the Savannah River reprocessing plants presently have the capability of solidifying acidic HLW. Liquid HLW is neutralized to high pH and stored in underground steel tanks. Plans for final processing and disposal of these wastes at Savannah River include conversion of the sludges containing fission products and actinides to an immobile solid form in canisters for disposal in a Federal repository. After the radioactive cesium is removed, the supernate containing salts would be disposed of as low-level waste (LLW). The radioactive cesium might be used as radiation source or would be combined with the sludge containing the rest of the fission products and actinides. Disposal of HLW at the Hanford facility could be similar, although other alternatives are being considered. In either case the volume of HLW added to the existing and projected waste systems from the processing of CRBRP spent fuel would be small. Thus the environmental effects of CRBR HLW processing and handling at Hanford or Savannah River Plant are not judged to be significantly different from that for the DRP alternative.

D.2.2 Waste Management Impacts

Sources of waste streams and impacts associated with storage and disposal of radioactive wastes produced by the CRBR fuel cycle are addressed and summarized in this section.

D.2.2.1 Waste Stream Sources

Radioactive wastes produced as a result of the CRBR fuel cycle would include those from the blanket fuel fabrication plant, the core fuel fabrication facility, the reactor plant, and the fuel reprocessing plant. Estimated waste quantities produced by the CRBR fuel cycle are presented in Table D.9. The cumulative waste quantities are based on a 30-year operating life of the proposed CRBRP and assume material flows as outlined in Figure D.1.

*Based, for example, on the annual discharge rate from N reactor through the Purex Plant at Hanford (assumed by the staff to be about 500 MTU/yr irradiated to approximately 2000 MWd/MTU), compared to the discharge rate and irradiation level of the CRBRP fuels.

Table D.9 Radioactive wastes from the CRBR fuel cycle (a)

Facility	Waste Type	Waste Form	Waste Container	Avg. Ann. Vol. (Cubic Meters)	Cum. Vol. (Cubic Meters)	Cumulative Containers	Activity Concentration (Ci/m ³)
Blanket Fuel fabrication plant	LLW (U)	Calcium fluoride	Bulk	5.5 (b)	170 (b)	NA (c)	2E-2
Core fuel fabrication plant	TRU (U, Pu, TRU)	Solid, compacted	55-gallon drums	130 (d)	3900 (d)	4350	6.4E+1
CRBRP plant	LLW	Solid, concrete	55-gallon drums	67	2000	9630	< 1E+2
	Evaporator bottoms, derived from metallic sodium treatment	Solid, concrete	55-gallon drums	0.4	12	60	< 1E+2
	Solids containing sodium compounds	Solid, Concrete	55-gallon drums	21	630	2940	< 1E+2
Fuel reprocessing plant	LLW (FP, AP) (f)	Concrete	55-gallon drums	25	750	3600	1E+1
	TRU (FP, TRU) (f)	Concrete	55-gallon drums	10	300	1500	1E+3 - 1E+6
	Metal scrap (TRU)	Metal	10" Dx10' H canisters	14	420	3060	4E+5
	HLW (FP, AP, TRU) (f)	Glass	12" Dx10' H canisters	3.3 (e)	100 (e)	180	1.5E+7
	Kr-85	Metal	9" Dx65" H canisters	0.01	0.3	1-2	3.4E+6
	I-129 (barium iodate)	Concrete	55-gallon drums	0.01	0.3	1-2	1.4E+2

(a) Based on ER Amendment XIV (DOE 1982).

(b) Assuming a bulk, settled density of about 2 g/cubic centimeter for calcium fluoride.

(c) Not applicable.

(d) This 130 cubic meters could be reduced to 30 cubic meters by compaction, for a cumulative volume of 900 cubic meters.

(e) Includes volume of overpack. Volume of glass is 1.1 cubic meters annually for a cumulative volume of 33 cubic meters of glass.

(f) FP - fission products; AP-activation products.

D.2.2.1.1 Blanket Fuel Fabrication Plant

Conversion of depleted UF_6 to UO_2 for the CRBRP blanket is planned to be performed at the blanket fuel fabrication facility. During UF_6 conversion, calcium fluoride (CaF_2) would be formed at a rate of 11 MT (5.5 cubic meters) per year (1 MT CaF_2 /MTU). This low level waste, containing about 0.01 micro-curies per gram of uranium would be disposed of at the blanket fuel fabrication facility in bulk form.

D.2.2.1.2 Core Fuel Fabrication Facility

Core fuel for the CRBRP is expected to be produced in the SAF line which is proposed as part of the FMEF. Approximately 65% of the SAF line capacity would be required annually to fabricate CRBRP core fuel. This would result in roughly 130 m^3 of TRU waste (64 Ci/m^3) being generated annually from production of CRBRP fuel. These wastes would be compacted, packed in approximately 145 55-gallon drums and stored in a retrievable mode for a maximum of 20 years at the Hanford Reservation. These TRU wastes would be less than 3% of the TRU waste already at the Hanford facility and should have an insignificant incremental environmental impact. Eventually DOE anticipates disposing of these TRU wastes in a Federal repository.

D.2.2.1.3 Clinch River Breeder Reactor Plant

The CRBRP would generate LLW, metallic sodium, and sodium bearing solids in the course of producing electrical energy. LLW would be generated at a rate of 67 m^3 per year, sodium bearing solids at 21 m^3 per year, and metallic sodium at 0.4 m^3 per year. This would result in the generation of approximately 425 55-gallon drums annually at the CRBRP, of which about 321 would contain LLW, about 100 would contain treated sodium bearing solids, and the rest would contain unreactive sodium compounds converted from two drums of metallic sodium. The LLW containing $< 100\text{ Ci/m}^3$ fission and activation products would be packed in 55-gallon drums and disposed of at a commercial burial site. Metallic sodium waste and sodium-bearing solids would be stored on site until they can be treated to convert sodium to unreactive forms such as oxide or nitrate. It is assumed that the unreactive forms would be solidified and/or packaged for shipment to and disposal in a commercial shallow-land burial site. The metallic sodium would be converted to aqueous nitrate and concentrated by evaporation. The evaporator bottoms will be solidified and shipped to a commercial shallow-land burial site.

D.2.2.1.4. Fuel Reprocessing Plant

Several types of wastes would be generated by the fuel reprocessing plant which supports the CRBR fuel cycle. LLW, containing short-lived fission and activation products at a total activity level of approximately 10 Ci/m^3 will be generated at a rate of 25 m^3 annually. This waste would be fixed in concrete and packaged in 120 55-gallon drums for disposal in a commercial shallow-land burial ground.

Approximately 10 m^3 of transuranic wastes would be produced per year. These wastes containing fission products and TRU would range from 10^3 Ci/m^3 to 10^6 Ci/m^3 in total activity. These wastes would be fixed in concrete, packaged in 50 55-gallon drums and eventually disposed of in a Federal repository.

Approximately 14 m^3 of metal scrap having a total activity of about $4 \times 10^5 \text{ Ci/m}^3$ would be generated each year. The metal scrap from disassembly of fuel, blanket, and shield assemblies and control rods would be partially compacted and packaged in 25.4-cm (10-in.) diameter by 3.1-m (10-ft) high canisters. One hundred and two canisters would be used annually. Final disposal would be in a Federal repository.

Approximately 1 m^3 of solidified HLW (3.3 m^3 with overpacks) containing $1.5 \times 10^7 \text{ Ci/m}^3$ of fission products and traces of fuel would be produced per year. The HLW would be fixed in a low leach rate matrix and packaged in six 30.5-cm (12 in.) diameter 3.1-m (10 ft) high canisters and eventually transported to a Federal repository for disposal.

Some Kr-85 would be captured during reprocessing and, using a sputtering process, the Kr-85 would be implanted in a metal matrix. This material, with a specific activity of $3.4 \times 10^6 \text{ Ci/m}^3$, would be loaded into a 22.9 cm (9-in)-diameter by 165-cm (65-in.) high canister. One of these canisters would be required for every 28 years of CRBRP operation. These canisters are assumed to be disposed of in shallow dry wells at a Federal repository.

Iodine-129, as barium iodate (specific activity of $1.4 \times 10^2 \text{ Ci/m}^3$), would be fixed in concrete and placed in 55-gallon drums. Roughly one drum would be generated during 20 years of CRBRP operation. This material is assumed to be shipped eventually to a Federal repository for disposal.

D.2.2.2 Storage Impacts

Transuranic waste would be stored for a period of time prior to disposal. Approximately 6000 55-gallon drums and 3000 canisters of metal scrap would be generated as a result of the 30-year CRBR fuel cycle operation. It is assumed that the drums would be stored retrievably in trenches and stacked 12 deep by 12 across and 4 high (Rockwell 1982). Using the Rockwell configuration for the drums, and assuming an equivalent requirement for the canisters, the total land area required for TRU waste storage is estimated at 0.4 ha (1 acre). This land is considered temporarily committed since, after the 20 years of storage, the waste could be transferred to a Federal repository and the storage site could be decommissioned and made available for other purposes.

D.2.2.3 Burial Ground Impacts

LLW from both the fuel reprocessing plant and the CRBRP would be disposed of at a commercial ground. It is assumed that eventually the reactive sodium components would be converted to an unreactive form, and that these wastes would also be disposed by burial. Three types of impacts were identified at the burial site: commitment of land, consumption of fuel, and long-term radiological population exposure.

Over the 30-year period for the CRBR fuel cycle, approximately 17,000 55-gallon drums (3500 m^3) would require burial. As perspective, a typical disposal trench (NRC 1981a) has a capacity of $17,000 \text{ m}^3$. Thus, for its lifetime the CRBRP would require about one fifth of a typical LLW disposal trench. Currently, 2 million m^3

of space is estimated to be available in existing LLW disposal sites (EG&G 1980). Thus, the LLW from the CRBRP fuel cycle, which is similar to other commercial LLW, represents 0.2% of the current LLW disposal capacity.

Based on the reference burial ground (NRC 1981a), it is estimated that 0.1 ha (0.25 acres) of trench area will be necessary to dispose of CRBRP low-level wastes. If support areas at the burial ground are also allocated to the CRBR fuel cycle based on the ratio of CRBRP wastes to the burial ground capacity, then an additional 0.1 ha (0.25 acres) will be considered committed. The total burial ground area committed as a result of the disposal of LLW wastes from the CRBR fuel cycle will then be approximately 0.2 ha (0.5 acres). This land is considered permanently committed.

Fuel consumption requirements were developed based on parameters in NRC 1981a. Estimates of fuel use were made for burial ground construction, waste loading, and post-operational monitoring. The fuel requirements for the reference burial ground (described in NRC 1981a) were prorated to that portion of the site which would be occupied by CRBRP LLW wastes. The fuel requirement for the life of the CRBRP is estimated at approximately 10 m^3 (2700 gallons).

Long-term radiological exposures from radioactive waste disposal are discussed in Section D.2.4.4.

D.2.2.4 Repository Impacts

It is assumed that TRU waste from the core fuel fabrication plant and all non-LLW from the fuel reprocessing plant would be disposed of in a Federal repository. Impacts from a repository can be grouped into three general areas: radiological releases, non-radiological effluents, and resource requirements.

Radiological releases in the near term are associated with construction of the repository and consist of increased releases of naturally occurring radon and its decay products at the construction site. For the longer term, DOE states that the Federal repository is to be designed such that there will be reasonable assurance that wastes will be isolated from the accessible environment for a period of at least 10,000 years with no prediction of significant decreases in isolation beyond that time (DOE 1980c).

DOE has projected Federal repository characteristics for the disposal of LWR fuel and/or high level wastes for four geologic media (DOE 1980b). This information is used in some portions of the following NRC review. A qualitative comparison between LWR HLW and CRBR HLW to be disposed of in a repository (DOE 1979) results in the following findings:

- The expected generation rate per GWe-yr of HLW for LWRs (DOE 1979) is approximately equivalent to that predicted for the CRBR fuel cycle on a volumetric basis.
- The isotopic composition of CRBR HLW (NRC 1982a) is similar to that of LWR HLW (DOE 1980b), as shown in Table D.10. While some of the plutonium isotopes from the CRBR fuel cycle have a higher activity level, these constitute a small fraction of the entire HLW inventory.

Table D.10 Comparison of high-level waste from CRBRP with high-level waste from LWRs

Radionuclide	Curies/MTHM	
	CRBR	LWR*
H-3	0	4.2E+2
Sr-90	2.6E+4	6.1E+4
Ru-103	2.6E+2	7.4E+1
Ru-106	3.4E+5	1.9E+5
Cs-134	2.3E+4	1.2E+5
Cs-137	1.3E+4	9.3E+4
Ce-144	2.6E+5	2.4E+5
U-234	6.6E-5	1.7E-3
U-236	4.0E-3	1.3E-3
Np-237	7.3E-2	4.0E-1
Pu-238	1.3E+2	2.8E+1
Pu-239	2.3E+1	1.8
Pu-240	1.4E+1	3.7
Pu-241	6.8E+2	8.7E+2
Pu-242	4.3E-3	2.0E-2
Am-241	1.0E+3	7.1E+2
Cm-242	6.8E+3	9.9E+3
Cm-244	5.7E+1	7.2E+3
Total	1.6E+6	1.4E+6

*From Reference DOE 1980b, Tables 3.3.9 and 3.3.14, at about 1.5 years after reactor discharge.

- The radioactivity, thermal power and ingestion toxicity for CRBR HLW and PWR HLW are essentially similar for their entire decay lifetimes (NRC 1982a).

The staff concludes from this comparison that the LWR assessment (DOE 1980b) provides a qualitative measure of the impact of CRBR HLW in a Federal repository. This conclusion is consistent with that reported by DOE in ER Amendment XIV.

The total repository disposal requirements of the CRBR fuel cycle over its projected lifetime (approximately 30 years) include approximately 100 m³ of HLW in overpacked containers and 4600 m³ of TRU waste (including metal scrap from the fuel reprocessing plant). Impacts from the disposal of CRBR wastes were estimated by prorating the disposal impacts outlined in DOE (1980b) to that portion of the reference repositories in candidate geologic media (salt, granite, shale, or basalt) which would be allocated to CRBR waste. On the basis of the equivalent area required to dispose of the canisters sent to a repository from the CRBR fuel cycle 6000 55-gallon drums of TRU, 3000 canisters of metal scrap TRU, and 180 canisters of HLW, not more than 1/100th of a reference repository (DOE 1979) would be occupied by wastes from the CRBR

fuel cycle. As discussed in more detail in Section D.2.4.4, releases of radioactive materials from a repository would be limited to generic values specified in the environmental radiation protection standards currently being developed by the U.S. Environmental Protection Agency. While these standards have not yet been published, they are expected to limit total repository impacts to levels which are smaller than the impacts from natural radiation sources, unmined uranium ore, or the balance of the uranium fuel cycle. The impacts attributable to the CRBRP wastes are projected to be less than 1/100th of the total impacts of a high-level waste repository, and therefore would be insignificant compared to natural sources of radiation.

In the case of waste disposal in a geologic repository, construction of the repository would involve extractions of rock in a manner comparable to other underground mining operations. In the process of mining, release to the atmosphere of naturally occurring radionuclides from the rock would be increased. This increased release of radionuclides can be typified by the release of radon and its decay products from the mine. It is estimated that for CRBR these releases would range from about 6×10^{-5} Ci/yr from a repository in salt to about 0.5 Ci/yr from a repository in granite (1/100th of values reported in DOE 1980). The resulting 70-year dose to the regional populations in the vicinity of the repository would range from about 7×10^{-5} person-rem for a repository in salt to about 1 person-rem for a repository in granite. For perspective the same population would annually receive about 1.4×10^7 person-rem from other naturally occurring sources.

Nonradiological effluents released from repository construction and operation result from generation of dust and effluents from machinery and are presented in Table D.11. These projected releases would not exceed Federal Air Quality Standards, as outlined in 40 CFR 50, at the repository boundary (1.6 km from the point of emission). These quantities are developed from emission factors and estimates of fuel requirements (OWI 1978; URS 1977).

Table D.11 Annual release of nonradiological effluents from repository construction and operation attributable to CRBR fuel cycle wastes*

Effluent (MT)	Geological medium			
	Salt	Granite	Shale	Basalt
Sulfur oxides	21	21	14	19
Nitrogen oxides	11	12	9.4	11
Hydrocarbons	0.52	0.65	0.42	0.57
Carbon monoxide	13	23	13	21
Particulates	4.9	4.9	3.3	4.5
Heat (MJ)	2.5E+5	2.8E+5	1.4E+5	2.3E+5

*Construction and operation periods vary with geologic media; values shown are largest annual releases.

For purposes of providing perspective on such effluents, annual emissions from oil-burning space heaters in a town of about 30,000 are estimated to be 11 MT of CO, 6 MT of hydrocarbons, 27 MT of nitrogen oxide, 300 MT of sulfur oxides, and 23 MT of particulates. In all cases these effluents are in the range of or greater than the repository releases.

Thus, the staff judges that the non-radiological impacts from the construction and operation of a repository in support of the CRBR fuel cycle are insignificant when compared to effluents from other routine type activities.

Annual resource requirements associated with CRBR fuel cycle wastes at a geological repository are given in Table D.12.

Table D.12 Annual resource requirements for CRBR fuel cycle waste disposal in a repository*

Resource Requirement	Geological medium			
	Salt	Granite	Shale	Basalt
Land (ha)				
Temporary	0.06	0.07	0.06	0.07
Permanent	0.02	0.04	0.02	0.04
Total	0.08	0.11	0.08	0.11
Water (millions of gal)	0.1	0.2	0.1	0.2
Fuel				
Electricity (MJ)	2.5E+6	3.1E+6	1.7E+6	2.8E+6
Diesel fuel (m ³)	90	100	67	90
Coal (MT)	470	470	310	430
Materials				
Concrete (m ³)	160	300	170	270
Steel (MT)	26	47	27	43
Steam (MT)	5000	5300	3300	4700
Staffing (person-yr)	10	15.0	8.7	16.0

*Annual requirements vary between construction and operation; values shown are the largest annual requirements.

For perspective, the approximate annual U.S. production of some of the resources identified in Table D.12 is shown below. Manpower is that expended in the construction and mining industries (DOE 1980b).

Resource	Annual U.S. production or use
Concrete, m ³	7E+7
Steel MT	1E+8
Electricity MJ	7.2E+12
Diesel fuel,	4E+8
Staffing, person-years	4E+6

Thus, the resource requirements for the CRBRP contribution to a repository are small in comparison with the annual U.S. production or use of such resources for other purposes, i.e., in the range of 0.0001 to 0.01%.

The lifetime land requirements are based on CRBR wastes requiring about 1% of both the area occupied by surface facilities and the area underneath excess rock storage piles at the repositories. The land occupied by surface facilities (1.8 ha for salt and shale and 2.2 ha for granite and basalt) could be considered temporarily committed because after the repository is decommissioned and any post-closure monitoring activity is completed, the surface land could be used for other purposes. However, land underlying the excess rock storage pile (0.7 ha for salt, 0.5 ha for shale, and 1.2 ha for granite and basalt) would be considered permanently committed.

D.2.2.5 Summary of Overall Waste Management Environmental Considerations

Annual waste management environmental considerations associated with the CRBR fuel cycle for LLW, TRU waste, and HLW are presented in Table D.13. The range in impacts reflects differences which might be observed depending upon whether the Federal repository is in salt, granite, shale, or basalt. In the staff's estimation, CRBR waste management requirements do not constitute a significant environmental impact. In all cases (i.e., storage, burial ground, repository), the relatively small amount of wastes from the CRBR fuel cycle that would be stored and/or disposed of at facilities being planned for other nuclear requirements would constitute a very small increment to those facilities' other needs. Thus, the contribution of CRBR fuel cycle wastes would be minor by comparison to the total waste management activities occurring at these facilities.

Table D.13 Annual waste management environmental considerations from the CRBR fuel cycle

Effect	Range (a)
Land (ha) (b)	
Temporarily committed (ha)	0.07 - 0.08
Permanently committed (ha)	0.03 - 0.05
Total	0.10 - 0.13
Water (millions of gal)	0.1 - 0.2
Fuel	
Electricity (MJ)	1.7E+6 - 3.1E+6
Coal (MT)	310 - 470
Effluents-Chemical (MT)	
Sulfur oxides	14 - 21
Nitrogen oxides	9 - 12
Hydrocarbons	0.42 - 0.65
Carbon monoxide	13 - 23
Particulates	3.3 - 4.9
Effluents-Radiological (Ci)	
Radon and decay product	6E-5 - 5E-1
Other radionuclides	(c)
Thermal (MJ)	1.4E+5 - 2.8E+5

- (a) Values shown are the range over geologic media and the periods of repository construction and operation.
- (b) Land commitments include that required for storage of TRU wastes at Hanford and for LLW burial, and land associated with the repository.
- (c) The staff believes these values to be negligible by comparison with similar effects from other fuel cycle steps.

D.2.3 Transportation Impacts

Operation of the CRBRP would require the transportation of a variety of radioactive materials between the power plant and the supporting fuel cycle facilities. Although the exact location of some of the supporting facilities is not yet known, it is anticipated that they would be situated in different parts of the country. In terms of potential environmental impacts, it thus becomes important to quantify the many transportation steps required to support the CRBRP.

Radioactive materials transported in the CRBR fuel cycle involve a variety of physical and chemical forms, but basically can be divided into three categories: fresh fuel materials and assemblies, irradiated materials, and radioactive

Table D.14 Summary of fuel materials and quantities shipped for the CRBR equilibrium annual fuel cycle

Type of Shipment	Mode of Transport	Quantity Shipped Per Year(a) (kg)	Quantity Shipped Per Shipment(a) (kg)	Heat Generation Rate Per Shipment (W)	Estimated Activity Per Shipment (Ci)	Avg. No of Shipments Per Year	Est. Avg. Shipping Distance (km)	Shipment Destination(b)
<u>Fresh Fuel Material</u>								
Uranium hexafluoride	Truck	11,100	8,430		3.73	1.3	4,000	BFP
Uranium dioxide	Truck	4,020	4,020		1.35	1	4,000	FMEF
Plutonium dioxide	Truck	890	64		6.4E+3	14	4,830	FMEF
Fresh Core Rods	Truck	4,889	360		6.6E+3	14	16	FOL
Fresh Core Assembly	Truck	4,889	360		6.6E+3	14	4,000	CRBRP
Fresh Blanket Assembly	Truck	6,980	600		0.20 (c)	12	4,000	CRBRP
						56.3		
<u>Irradiated Material</u>								
Spent Core Assembly	Rail	4,670	330	2.0E+4	4.8E+6	14	4,000	DRP
Spent Blanket Assembly	Rail	6,920	580	5.4E+3 (c)	1.4E+6 (c)	12	4,000	DRP
Radial Shield and Control Rod Assembly	Rail	NA (d)	NA	NA	NA	4.5	4,000	DRP
						30.5		

(a) Quantities of materials shipped are given in kilograms of heavy metal.

(b) BFP: Blanket fabrication plant.

(c) Weighted average of inner and outer radial blankets.

(d) Not available.

Table D.15 Summary of radioactive solid waste and quantities shipped for the CRBRP equilibrium annual fuel cycle

Type Shipment	Mode of Transport	Quantity Shipped Per Year (Cubic Meters)	Quantity Shipped Per Shipment (Cubic Meters)	Number of Containers Per Year	Heat Generation Rate Per Shipment (W)	Estimated Activity Per Shipment (Ci)	Avg. No. of Shipments Per Year	Est. Avg. Shipping Distance (km)	Shipment Destination(a)
<u>Waste From Fuel Preparation and Fabrication Plants</u>									
TRU Waste	Truck	30	6	145		1,660	5	7,000	FR
<u>Waste from CRBRP</u>									
LLW Evaporator Bottoms (b)	Truck	67	8.4	321		840	8	4,000	BG
Treated sodium containing solids	Truck	0.4	8	2		NA	0.05	4,000	BG
	Truck	21	10	100		NA	2.1	4,000	BG
<u>Waste from Reprocessing Plant</u>									
LLW	Truck	25	12.6	120		130	2	4,000	BG
TRU Waste	Truck	10	1.4	50		7.0E+5	7.1	4,000	FR
Metal Scrap	Truck	14	0.8	102		3.4E+5	17	4,000	FR
HLW	Rail	1	0.3	6	2.6E+4	6.0E+6	3	4,000	FR
Noble Gases	Truck	0.01	0.3	0.035		1.0E+6	0.035	4,000	FR
Iodine	Truck	0.01	0.3	0.05		< 50	0.03	4,000	FR
							45 (c)		

(a) FR: Federal repository; BG: Burial ground.

(b) From treated sodium coolant

(c) 42 Truck and 3 rail.

wastes. The first category includes depleted uranium hexafluoride, depleted uranium oxide, plutonium dioxide, fresh core rods, and fresh core and blanket assemblies. These materials would constitute the basic fuel for the reactor. Irradiated fuel and blanket assemblies, as well as exhausted radial shield and control rod assemblies, are transported from the reactor to the reprocessing plant. Radioactive wastes from the reprocessing plant, from the fuel fabrication plants, and from the CRBRP would have to be transported eventually to either a shallow-land burial ground or to a geologic repository. The estimated number of shipments and the quantities of these materials that would be generated in the operation of the CRBR fuel cycle, the general characteristics of these materials, and the number of shipments per year required during CRBRP equilibrium operations are summarized in Tables D.14 and D.15.

Commercial packaging and transport of radioactive materials are regulated at the Federal level by the Department of Transportation (DOT). Shipment by the DOE is done in accordance with DOE Orders. The regulations for package design and control of shipments are designed to protect the public and transport workers from external radiation and exposure to the contained radioactive materials during shipment. Primary reliance for safety in transport of radioactive material is placed on the packaging. The packaging must meet applicable Federal and state regulatory standards which provide that the packaging shall prevent loss or dispersal of the radioactive contents, retain shielding efficiency, assure nuclear criticality safety, and provide adequate heat dissipation under both normal conditions of transport and specified damage test conditions (i.e., design basis accidents). Package contents must also be controlled so that standards for external radiation levels, temperature, pressure, and containment are met.

D.2.3.1 Heat Load Impacts

The heat load per shipment for all fresh fuel materials would be expected to have essentially no impact on the environment. The temperature of the outer surfaces of these packages would be no higher than 50°F above the average ambient air temperature. With regard to the irradiated materials and wastes being transported in the CRBR fuel cycle, the spent core and blanket assemblies and HLW shipments would release somewhat more heat to the environment. The heat load per shipment for these materials is shown in Tables D.14 and D.15.

Thermal releases would result from shipping spent core and blanket assemblies and HLW by rail. Based on the data on heat generation shown in Table D-14 and D.15 and data provided by DOE on length of travel time (DOE 1982), the thermal releases are estimated to be about $2.1\text{E}+5$ MJ annually.

With regard to the heat impacts of spent fuel and HLW, this analysis has been based upon the heat generated from these materials at their assumed shipment times of 100 days and 1 year after discharge, respectively, since these times represent maximum or bounding conditions. The design rate of release of heat to the air from casks for transport of irradiated materials and HLW is stated by the applicant to be about 26 kW, or about 90,000 Btu/hr. This rate can be compared with the rate of 50 kW or 180,000 Btu/hr released as waste heat from a 100-hp truck engine operating at full power. The temperature of the cask surface would be less than 50° F above ambient temperature. Federal regulations (49 CFR 173.393) restrict the temperature of accessible cask surfaces to a maximum of 180°F. Because the amount of heat would be small and would be

released over the entire transportation route, no appreciable effect on the environment would result.

D.2.3.2 Traffic Density Impacts

Radioactive materials in the CRBRP fuel cycle are transported primarily by truck or train. Except in the case of plutonium containing materials and HLW which must be safeguarded against theft and sabotage (see Appendix E), shipments in the CRBR fuel cycle would be made using commercial shipping systems. As shown in Tables D.14 and D.15, operation of the CRBRP would require approximately 56 shipments by truck per year of fresh fuel material, 33 shipments by rail per year of irradiated fuel components and wastes, and 42 shipments by truck per year of radioactive wastes.

The shipments in support of the CRBRP would be over public roads via truck for fresh fuel material and some waste shipments. The number of these shipments would be very small compared with normally expected traffic density on highways. Irradiated material shipments to the reprocessing plant and shipments of HLW from the plant would be made by rail car. Shipping irradiated assemblies and HLW would involve about 30 rail car shipments annually. This is very small compared with commercial rail shipments annually. Thus the total number of shipments would be too small to have any measurable effect on the environment as a result of increased traffic density.

According to DOE, there are approximately 720,000 truck km (450,000 truck miles) required annually for shipping CRBR fuel and waste materials (DOE 1982). The staff finds this is a reasonable estimate based on data in Tables D.14 and D.15. At 4.9 miles/gallon (NRC 1976c), approximately 92,000 gallons of diesel fuel would be used annually to ship these materials by truck. An additional small increment of diesel fuel would be used in rail shipment of spent assemblies and HLW. The staff concludes that the fuel attributable to the car carrying a spent fuel or HLW cask would be but a small fraction of the fuel required for the total train and is within the error of estimate of diesel fuel required for truck shipment. On the basis of emission yields for diesel engines from NRC 1976c, combustion of 92,000 gallons of diesel fuel would release about 9.4, 1.5, 15.4, 1.1, and 0.5 MT respectively of CO, hydrocarbons, nitrogen oxides, sulfur oxides, and particulates.

D.2.4 Radiological Impacts

The staff has estimated the dose commitment to the U.S. population (hereafter referred to as the population dose) from exposure to annual releases of radioactive effluents from normal operation of fuel cycle facilities and from transport of radioactive materials supporting the CRBR fuel cycle.

D.2.4.1 Dose Commitments from Blanket Fuel Fabrication

Radiological doses resulting from the conversion of depleted uranium hexafluoride to uranium dioxide and the fabrication of blanket fuel assemblies will depend, to some extent, on the commercial facility chosen to perform these functions. However, such effects can be projected on a generic basis from the environmental impact assessments of existing commercial U.S. uranium fuel fabrication plants (NRC 1977b, 1981b, and 1982b). On these bases, the population doses to the whole body from exposure to radioactive effluents from the fabrication of blanket assemblies for the CRBRP are expected to be less than 0.1 person-rem annually.

D.2.4.2 Dose Commitments from Core Fuel Fabrication (FMEF and Building 308)

Population dose estimates for the fabrication of mixed oxide core fuel rods for the CRBRP are based on the annual releases listed in Table D.4 for the SAF line, using an environmental dose commitment (EDC) time of 100 years*. The computational code used for these estimates is the RABGAD code originally developed for use in the "Generic Environmental Impact Statement on the Use of Mixed Oxide Fuel in Light-Water-Cooled Nuclear Power Plants," GESMO (NRC 1976a).

The following environmental pathways were considered in estimating doses: (1) inhalation and submersion in the plume during its initial passage; (2) ingestion of food; (3) external exposure from radionuclides deposited on soil; and (4) atmospheric resuspension of radionuclides deposited on soil. Radionuclides released to the atmosphere are assumed to be transported with a mean speed of 2 m/sec over a 4000-km pathway from the State of Washington to the northeast corner of the United States, and deposited on vegetation (deposition velocity of 1.0 cm/sec) with subsequent uptake by milk and meat producing animals. No removal mechanisms are assumed during the first 100 years (radioactive decay is negligible) except normal weathering from crops to soil (weathering half-life of 13 days).

The following agricultural and population characteristics were used in computing doses:

- . Annual food crop production is 100 kg/day/mi²
- . Annual milk production is 90 liters/day/mi²
- . Annual meat production is 65 kg/day/mi²
- . Population density (based on the U.S. census for 1970 and allowing for about a 50% increase in the population) increases exponentially from 75 people/mi² in the State of Washington to 1500 people/mi² at the East Coast (NRC 1979).

The bases for the agricultural characteristics are described in GESMO (NRC 1976a).

Using the above bases, the U.S. population doses to the whole body and critical organs from exposure to radioactive effluents from the core fuel fabrication plant are estimated to be less than 0.1 person-rem. The staff projects that there will be no radiological releases from the core fuel assembly plant (Building 308), and thus doses to the population from the core assembly operation will be negligible.

D.2.4.3 Dose Commitments from Fuel Reprocessing

Population dose estimates for the reprocessing plant for irradiated CRBRP fuel assemblies are based on the annual releases listed in Table D.8 for the DRP. The RABGAD computer code was used to estimate doses using the preceding parameters, except for the following because of the likelihood of an eastern site for the DRP: (1) the radionuclide releases were assumed to be transported over a 2400-km pathway, to the northeast corner of the United States, and (2) the population density was assumed to be 235 people/mi². On this basis, the U.S.

*The environmental dose commitment (EDC) is the integrated population dose for a specific time period (e.g., 100 years), it represents the sum of the annual population doses for the total time period specified.

population dose to the whole body from exposure to radioactive effluents is estimated to be about 140 person-rems. Over 90% of this dose is due to exposure to tritium and carbon-14. Conservative (high side) estimates were used for source terms; consequently, the preceding dose is also conservative. Despite this bounding assessment, the dose commitment from the reprocessing plant is less than 0.001% of the annual natural background dose to the U.S. population.

D.2.4.4 Dose Commitments from Waste Management

The radioactive wastes from the CRBRP and its supporting fuel cycle would be similar to other wastes that have been generated in the past and are projected to be a small fraction of such wastes that would be generated in the next 30 years from commercial nuclear power operations. For low-level wastes, the CRBR wastes would represent less than 1.3% of the total curie content of the low-level wastes that will be disposed of at the reference disposal site assumed in the DEIS for 10 CFR 61 (NRC 1981a). The DEIS for 10 CFR 61 shows that the environmental effects of the reference disposal facility are small. Thus, the radiological effects of disposal of CRBRP low-level wastes would be negligible when compared to the total effects of low-level waste disposal.

The CRBR high-level wastes are projected to occupy less than 1% of the total inventory of a typical high-level waste repository. The CRBR wastes are not significantly different from other wastes that would be disposed of in a Federal repository (see Section D.2.2.4.) DOE has stated that high-level waste management facilities are to be designed in such a manner that there will be reasonable assurance that wastes will be isolated from the accessible environment for a period of at least 10,000 years with prediction of no significant decreases in isolation beyond that time.

DOE is currently conducting design studies for a HLW repository. However, until the design is finalized and a repository site has been selected, it would not be possible to quantify the long-term radiological impacts from HLW disposal at a specific site. Furthermore, the design of a repository (and the resulting impacts) would be strongly dependent on the generic performance standards with which the repository must comply. The U.S. Environmental Protection Agency (EPA) has the statutory responsibility for and has been working for 6 years to develop generic environmental radiation protection standards for disposal of HLW, but has not yet published these standards. In the absence of these standards, the radiological impacts of generic disposal of HLW cannot be quantified in a meaningful manner.

It is anticipated, however, that the EPA standards would limit the impacts of a HLW repository to levels small in comparison with natural radiation sources, unmined uranium ore, and the balance of the uranium fuel cycle. Since the HLW from the CRBRP would contribute less than 1/100th of the total inventory of a HLW repository, the radiological impacts from disposal of these wastes are expected to be insignificant compared to natural radiation sources.

D.2.4.5 Dose Commitments from Transportation

The principal radiological impacts from transport of radioactive materials are the direct radiation dose to the transport workers and bystanders. Persons along the transport route are also exposed during passage of the transport vehicle. In most cases, exposures are small and for a relatively short duration, but the number of persons who can be exposed may become large during a

trip of considerable distance. Additional doses may result from exposure to the public during stops for meals, crew rest, vehicle servicing and refueling.

Estimates of the doses to transport workers and the general population from the shipment of radioactive materials in the CRBR fuel cycle must be estimated in a generic manner because the locations of some fuel cycle operations and the storage or disposal site(s) for the radioactive wastes have not been firmly established. Using assumptions similar to those above for specific fuel cycle steps and based on average, conservative model conditions for radiation fields outside of packages, shipping distance, exposure times, and number of people exposed, the radiological doses from the transportation of radioactive materials for the CRBRP were conservatively (high side) derived using the methodology detailed in NUREG-0170 (NRC 1977c). These are summarized in Table D.16. As noted in the table, the overall radiation dose to transport workers and the general population is approximately 30 person-rem per year for the CRBRP and its related fuel cycle. The dose of 5 person-rem to the general population would

Table D.16 Estimated whole-body doses to transport workers and the general public from shipment of radioactive materials in the CRBR fuel cycle

		Person-Rems per Year	
		Transport Workers	General population
A.	Fresh Fuel Materials		
	Plutonium dioxide	3.2	0.67
	Fresh fuel		
	Core assemblies	2.7	0.56
	Blanket		
	Assemblies	0.11	0.0075
B.	Irradiated Materials		
	Spent fuel core assemblies	5.8	0.74
	Spent blanket assemblies	4.9	0.63
	Control rod and radial shield assemblies	0.007	0.0024
C.	Waste Materials		
	Fuel fab. plants		
	TRU waste	0.95	0.31
	CRBRP		
	Solid radwaste	1.5	0.50
	Reprocessing		
	TRU waste including metal scrap	4.6	1.5
	LLW	0.382	0.13
	HLW	1.2	0.18
D.	Total	25	5
E.	Total General Population and Transport Workers	30	

*Packages are assumed to meet DOT limits on external dose rates.

be distributed along the route among approximately 750,000 people. If 0.1 rem per person per year is conservatively chosen (low side) to represent the average exposure to the U.S. population from background radiation (the actual range is from about 100 to 250 mrem per person per year), these same people are calculated to receive about 75,000 person-rems per year.

Based on the above analysis, the staff concludes the doses to transport workers and the general population associated with the shipment of radioactive material to and from the CRBRP and its related fuel cycle facilities would be negligible (within the range of variation of natural radiation at a given location) and indistinguishable from the doses attributable to natural sources.

D.2.4.6 Summary of Radiological Impacts

The population dose to the total body of the U.S. population resulting from the CRBR fuel cycle operations is summarized in Table D.17. From the table the staff estimates that the dose to the total body from the annual operation of the CRBR supporting fuel cycle would be about 170 person-rems. Most of this dose is from exposure to radioactive effluents released from the fuel reprocessing plant. For perspective, the annual background radiation dose to the U.S. population (28 million person-rems) is included in Table D.17. The population dose to the total body of the entire U.S. population from exposure to radioactive effluents from routine operations of the CRBR fuel cycle facilities and operations is a small fraction (less than 0.001%) of the corresponding population dose from one 1 year of exposure to natural background radiation. Potential health impacts from exposure to radioactive effluents from routine operation of CRBRP and its supporting fuel cycle are discussed in Section 5.7.3.

Table D.17 U.S. population doses due to annual releases of radioactive effluents from routine operations of the CRBRP supporting fuel cycle

Source of exposure	Annual whole body dose (person-rems)
Blanket fuel assembly fabrication plant	<0.1 (a,b)
Core fuel assembly fabrication plant	<0.1 (a)
Fuel reprocessing plant	140
Transportation	30
Storage and disposal of radioactive waste	small (c)
Total (rounded)	170
Natural background (d)	28,000,000

- (a) The annual population doses to the bone, lung, kidney and GI tract are also less than 1 person-rem.
- (b) Based on environmental impact appraisals for existing commercial fuel fabrication plants of Westinghouse, General Electric, and Exxon, adjusted for CRBRP throughput.
- (c) Expected to be very small compared to the annual releases of the other fuel cycle steps.
- (d) Based upon a U.S. population of 280,000,000 persons (projected population for the year 2010) receiving a background dose of about 0.1 rem/yr.

D.2.4.7 Sensitivity Analysis of Fuel Cycle Options

The fuel cycle presented by DOE in Section 5.7 of Amendment XIV to the ER represents in the staff's view a simplified cycle for CRBRP fuel handling. The staff has qualitatively considered what it believes to be a somewhat more realistic overall fuel cycle. It employs a once-through or opened fuel cycle during the early years of the CRBRP operations, followed by a closed fuel cycle utilizing repeated recycle of plutonium materials during later CRBRP operations.

The once-through or opened fuel cycle mode would involve the supply of about 0.89 MT of fresh plutonium annually from DOE stockpiles to provide a constant quantity and isotopic composition of plutonium as input material for each reload for the CRBRP during the early operational period. For this fuel cycle mode, the front end of the fuel cycle would be essentially similar to that described in Sections D.2.1.1 and D.2.1.2 and assessed in Sections D.2.4.1 and D.2.4.2. Thus, for this mode no significant impact changes are expected from the front end of the fuel cycle. With regard to the back end of the fuel cycle without plutonium recycle, transportation of radioactive materials and waste management generally are either decreased or eliminated, and environmental impacts would be less. In overview, for this opened fuel cycle mode, actual impact levels should be somewhat lower than those presented in Table D.17; therefore, for this assessment, the impacts given are judged to be a clearly conservative representation of the opened fuel cycle mode.

Inspection of the other basic fuel cycle mode, that of the closed fuel cycle where the plutonium would be used for repeated cycling, presents a different set of conditions. In this mode the plutonium used would be of changing isotopic composition and quantity. The composition of plutonium discharged from the core region of the CRBRP might approach, in the limiting case of repeated irradiation, that of the LWR long burnup-type plutonium assumed by DOE for its assessment of the environmental impacts of the FMEF SAF line and DRP facilities. This type of plutonium, when combined with the plutonium contained in the blanket assemblies, may result in the need for an increase in plutonium content of CRBRP fuel of about 10 to 15% per annual reload to account for the decreased fissile concentration of the plutonium material. This would entail a small increase in the plutonium oxide shipments noted in Table D.14 that might result in an increase in whole body exposure to transport workers and the general population of less than 0.5 person-rem. In addition the changes in plutonium isotopic composition with repeated recycling would have some other potential effects on radiological exposures. However, the staff assessments of airborne effluents from fuel fabrication and fuel reprocessing operations were conservatively based upon the higher values of radionuclide content for either fresh stockpile plutonium or LWR long-burnup spent fuel plutonium. In this way the staff's conservative analysis bounded conditions that would be associated with effects of plutonium isotopic variation from the closed fuel cycle mode with the exception of the small 10 to 15% increase in plutonium quantities that might be required. In addition, it should be noted from Table D.17 that, in the staff's assessment, the bulk of the radiological dose to the population from the CRBR fuel cycle results from the fuel reprocessing and transportation steps. In the staff's evaluation of the fuel reprocessing step, the principal contributors to the radiological dose are releases of tritium and carbon-14, which are essentially unaffected by the variations in plutonium composition or throughput. In the transportation dose analyses, the packages are assumed to meet DOT limits for external dose rates and will be unaffected by variations

in plutonium composition. Thus, for the fuel cycle option represented by use of repeatedly recycling plutonium, the staff has adequately covered the potential effects by its conservative (high side) assumptions in its detailed analysis.

In this sensitivity analysis the staff has qualitatively considered reasonably expected variations to the simplified fuel cycle presented by DOE in the ER and believes that the reasonably expected modes of fuel cycle operation are bounded by the staff's conservative environmental assessment, which is summarized in Section D.2.4.6. Further, no significant perturbations to the overall assessment or staff conclusions would be anticipated from reasonably expected variations to the simplified fuel cycle presented by DOE.

D.2.5 Socioeconomic Impacts

Socioeconomic impacts of the CRBR fuel cycle would relate principally to the need for new facilities or operations or additional needs to already planned operations or nuclear facilities that would cause increases or changes in levels of employment and public services requirements. These impacts have been assessed with regard to:

- (1) population effect - changes in population resulting from the influx of workers and their families during the construction and operational stages of the facilities.
- (2) economic effect - induced changes in income and expenditures, including demands for services, both public and private.

The equilibrium CRBR fuel cycle would include new facilities for mixed-oxide (MOX) fuel fabrication and fuel reprocessing as well as additional needs for uranium element fabrication; management of LLW, HLW and TRU waste generated by facilities in the fuel cycle; and the transport of products and wastes between such activities. Most facilities are expected to be DOE owned and operated and to be substantially smaller than were postulated for a commercial breeder reactor economy (ERDA 1975a). While the CRBRP is in advanced stages of design and its site selected and the facility for fabrication of the core fuel for the reactor is under construction, the same cannot be said for some of the other portions of the fuel cycle. Most of the other fuel cycle facilities are in the conceptual stage and potential socioeconomic effects can only be considered qualitatively.

The staff has considered the socioeconomic impacts of the additions to already planned nuclear operations as noted below.

The plant for the fabrication of the blanket materials and assemblies, yet to be selected, would likely be one of several existing commercial uranium fuel fabrication facilities already in operation. It is expected that the existing normal production capacity of the facility would be many times that required for CRBRP. Any impacts of blanket fuel and material production would be a small and undifferentiable component of existing effects. Thus this CRBR operation has essentially no socioeconomic impacts.

Both the Federal high-level waste repository and the specific commercial low-level waste disposal facility that would be used for management of CRBR fuel cycle wastes are not established at this time. Regardless, the waste from CRBR

would contribute only a small portion to the total capacity of such planned facilities; thus any socioeconomic impacts associated with CRBR waste management would be a small increment to overall U.S. waste management socioeconomic impacts. In addition, socioeconomic effects of a geologic repository were assessed (DOE 1980b) and found not to be limiting in terms of a cost/benefit balance.

The materials to be transported are not unlike materials already planned to be transported to sites of several fuel cycle operations that are planned but yet to be specifically established. Thus, socioeconomic effects of transportation of radioactive materials to and from the various fuel cycle operations are assessed on a generic basis. Assumed distances between facilities were such that the analysis would tend to overestimate rather than underestimate consequences. Further, it is noted that transportation required for the CRBR would be a small fraction of that required for the commercial nuclear fuel cycle. The volume of transportation of radioactive materials associated with the CRBR fuel cycle would be insignificant in comparison with transport of materials for total U.S. nuclear energy production.

Socioeconomics of construction and operation of specific fuel cycle facilities principally associated with CRBR requirements appear to be manageable as in the case of other similar significant new projects as discussed below. These socioeconomic effects include those associated with the MOX fuel fabrication plant and a reprocessing plant. Therefore, the staff's assessment considered these special CRBR facilities.

The SAF line, one such special facility to be used for CRBR core fuel fabrication, will be built as part of the FMEF which is currently under construction on DOE's Hanford Reservation near Richland, Washington. Construction will take about 20 months and have a peak employment of 250 persons. Peak operational employment will be about 100 persons. The Hanford Reservation employs about 10,000 persons, and the metropolitan Richland area has a population of about 125,000 persons. The relatively small magnitude of the project compared to the Hanford complex and the small size of FMEF work force compared to the relatively large population and work force in the area would result in little socioeconomic impact during either construction or operation of the facility.

The facility for reprocessing CRBRP fuel is still in the formulative stage and several alternatives are still under consideration by the DOE. The one selected by NRC for this assessment, the Demonstration Reprocessing Plant (DRP), has been selected as a bounding alternative (high side) for impact assessment purposes, but its site is yet to be established and thus can only be considered generically. On the other hand, the facility would be expected to be smaller than the reference commercial reprocessing plant for LWR fuel reprocessing where socioeconomic effects in a hypothetical but reasonable environment were not found to be large.

The DRP, although principally designed for processing CRBR fuel, could also reprocess light water reactor fuel (LWR). The designed capacity will be about 150 MT/year. Approximately 12 MT/year of this capacity will be used for reprocessing CRBRP fuel. The location of the DRP has not yet been decided but it is likely that the location will be on a Federally owned site with large local work forces. The peak construction force is projected to be 3700, and the full operation work force about 750. Of this, about 8% would be attributable to the

CRBR fuel cycle. Assuming that the plant would most likely be built in a relatively urbanized area such as the Oak Ridge or Hanford sites, significant socioeconomic impacts would not be expected because of the availability of local labor and the ability of an urbanized area's services and facilities to absorb additional temporary population increases. In the event that the Oak Ridge reservation is the site for both the DRP and the CRBRP, then the CRBRP construction force would be decreasing as the DRP work force is increasing; thus the socioeconomic aspects of the DRP would tend to be a stabilizing factor for the additional construction period.

In summary, for those parts of the CRBR fuel cycle that are specifically associated with that project, the socioeconomic impacts have been considered qualitatively and at most would appear to be small (e.g., equivalent to any large capital project). For those portions of the fuel cycle that are similar to the commercial nuclear reactor fuel cycle, the incremental effect of the CRBR is very small (approximately 1%) and is not considered to be measurable or a significant increment. Thus, it is the staff assessment that the socioeconomic impact of the CRBR fuel cycle would not be a significant factor in the cost/benefit balance for decisions regarding the CRBRP.

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APPENDIX E

SAFEGUARDS RELATED TO THE CRBRP FUEL CYCLE AND TRANSPORTATION OF RADIOACTIVE MATERIALS

The material in this appendix replaces the material in Appendix E in the original issuance of the FES.

E.1. INTRODUCTION

The CRBRP was originally projected to be supported by a commercial fuel cycle where all the facilities would be NRC-licensed. There are no plans for such commercial operations at the present time; hence the Department of Energy (DOE) would support the CRBRP with its own fuel cycle facilities. Accordingly, DOE amended the CRBRP Environmental Report (AEC 1974) to cover the CRBRP fuel cycle, including DOE's proposed safeguards measures for all fuel cycle and transportation activities.

This appendix describes and assesses DOE's proposed safeguards for the CRBRP fuel cycle. To aid in the assessment, three general safeguards criteria are used:

1. Do DOE's proposed safeguards systems provide a potential for deterring attempts at theft or diversion of plutonium and attempts at sabotage of facilities or materials to be used in the CRBRP fuel cycle?
2. Are DOE's proposed safeguards systems likely to detect attempts at sabotage, theft, or diversion?
3. Do DOE's proposed systems for responding to attempted theft, diversion, or sabotage provide reasonable assurance that such attempts would not be successful?

Each fuel cycle facility and transport activity can be assessed by comparing its safeguards design features with the general safeguards criteria. A typical safeguards system contains both physical security systems and material control and accounting systems, and may contain the following features: access controls, intrusion detection systems, delaying mechanisms (fences, barriers, etc.), response systems, systems to detect unauthorized removals of plutonium, material measurement systems and records systems.

The assessment is based on Amendment XIV of DOE's CRBRP Environmental Report (DOE 1982)* and on literature expressly referenced in the Environmental Report. At this stage of the licensing process, only a general description of the fuel cycle components and their proposed safeguards systems is required. The proposed fuel cycle with plutonium material types** and the expected modes of material transportation is shown in Figure E.1.

*Also referred to as "the applicants' ER" in the main body of this report.

**Plutonium is the only SNM type in the CRBRP fuel cycle.

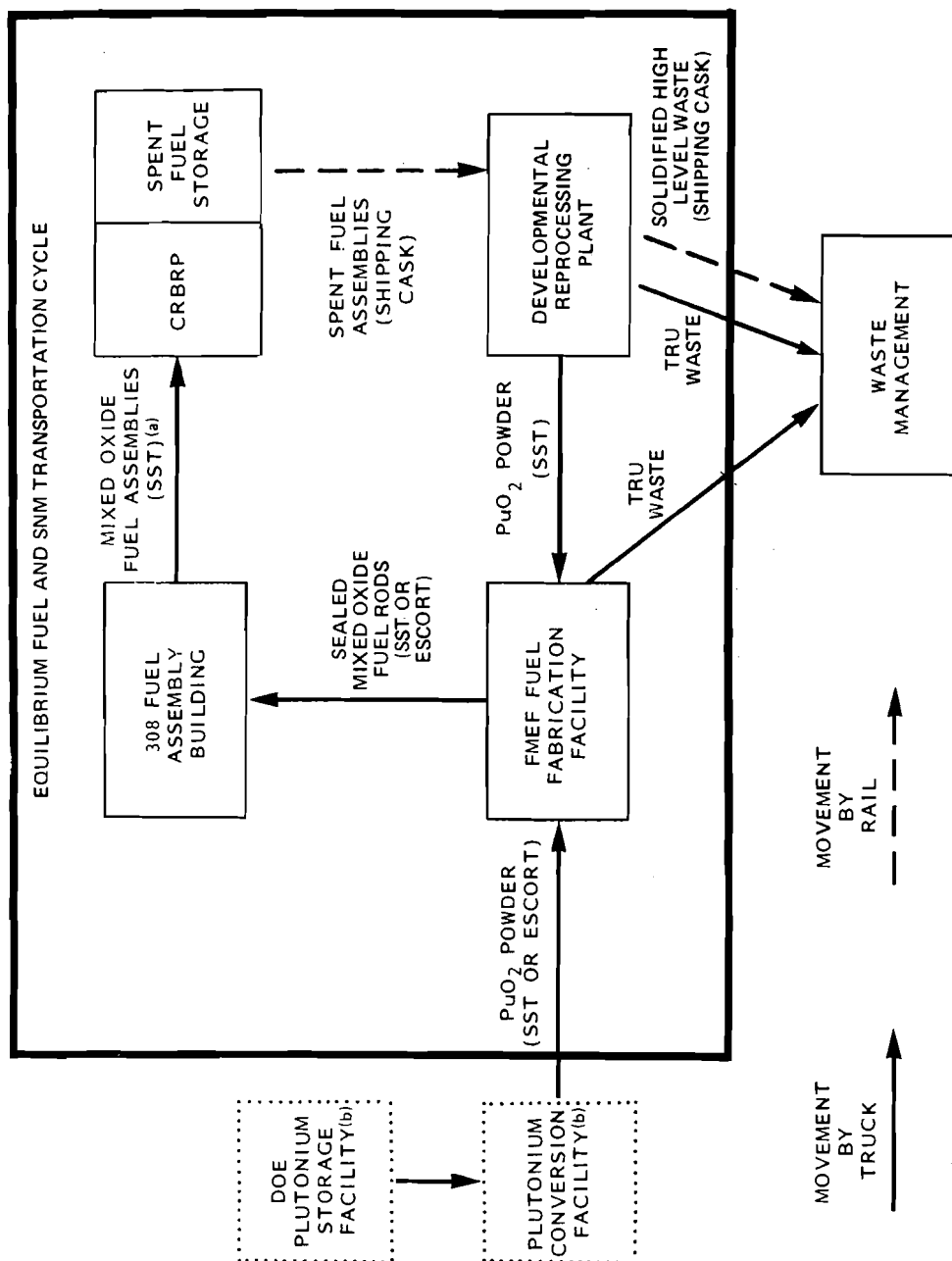


Figure E.1 CRBR Fuel Cycle, Plutonium Material Types and Transportation Links

The CRBR fuel cycle environmental review is unlike a similar review for light-water reactors for several reasons. The principal difference is that most of the fuel cycle facilities are to be owned and operated by DOE and would not be licensed. Similarly the transportation activities performed by DOE would not be subject to NRC regulation. Another difference is that most of these facilities are still conceptual and detailed safeguards systems are not yet designed for some of them. Of the CRBRP fuel cycle facilities, only Building 308 on the Hanford Reservation is operational today.

The remainder of this appendix is organized principally by fuel cycle activity. The design basis threats for the safeguards systems are described in Section E.2, followed by sections with descriptions of the DOE's proposed safeguards systems for plutonium conversion, MOX fuel fabrication, the CRBRP, fuel reprocessing, and waste storage facilities. Section E.8 describes the necessary transportation links in the fuel cycle and related safeguards measures. Each section considers the estimated cost of CRBR fuel cycle safeguards and assesses the potential for the proposed safeguards systems to meet the objectives stated above.

E.2. SAFEGUARDS DESIGN BASIS THREATS

E.2.1 NRC-DOE Threat Comparison

The safeguards systems described in this appendix are designed to counter design basis threats. The design basis threats contained in NRC's regulations (10 CFR 73.1(a)) would be used by DOE to protect against acts of radiological sabotage and to prevent the theft of plutonium at the proposed CRBRP. Safeguards systems for the associated, nonlicensed fuel cycle facilities would be designed in accordance with DOE's 1976 threat guidance. DOE threat guidance was revalidated in 1978 and remains in effect today.

NRC and DOE design basis threats are similar. The staff believes that safeguards programs designed in accordance with DOE's threat guidance will provide a level of protection against theft and sabotage that is at least as high as that provided by programs designed in accordance with NRC's design basis threats.

E.2.2 Summary of NRC Design Basis Threats

NRC design basis threats are detailed in 10 CFR 73.1(a). The threats are intended to provide guidance in the design of safeguards systems to protect against acts of radiological sabotage and to prevent theft or diversion of formula quantities* of special nuclear material. The safeguards system for sabotage shall be designed to protect against a determined violent external assault, attack by stealth, or deceptive action by several persons who are well trained and dedicated, aided by a knowledgeable insider, and equipped with suitable weapons and hand-carried equipment.

The safeguards system for theft or diversion shall be designed to prevent a determined violent external assault, attack by stealth, or deceptive actions by a small group who are well trained and dedicated, aided by a knowledgeable

*A formula quantity is defined in 10 CFR 73.2(bb).

insider, equipped with suitable weapons and hand-carried equipment, and capable of operating as two or more teams.

In addition, the safeguards systems shall be designed to protect against sabotage by a single insider and to prevent theft or diversion by a single insider and by a conspiracy between insiders.

E.2.3 NRC Policy on Clandestine Fission Explosives (CFE)

When designing safeguards systems to counter the design basis threat described above, the NRC does not assume any reduction in risk to the public due to difficulties that a non-national group might encounter in designing and building a CFE after obtaining two or more kilograms of plutonium. The staff recognizes that such risk reductions, although not quantifiable, are real, particularly in the case of a non-national group lacking necessary technical competence. Nevertheless, the staff concludes that such risk reductions are appropriately considered as an extra margin of conservatism. This staff policy on risk from clandestine fission explosives is based upon the following statement, contained in a memorandum from the NRC Executive Director of Operations on August 8, 1977: "Operating Assumption: It is assumed that a small non-national group of people could design and build a crude nuclear explosive device which would produce a significant nuclear yield, that is, a yield much greater than the yield of an equal mass of high explosive. To accomplish this, they would need an amount of special nuclear material which is at least equal to the five-kilogram formula quantity, and they would have to possess the appropriate technical capabilities." NRC regulations for protection against theft or diversion of formula quantities of SNM are consistent with this premise.

E.3. DOE SAFEGUARDS SYSTEM FOR PLUTONIUM CONVERSION

E.3.1 Physical Security System Description

Physical security systems for all DOE CRBRP fuel cycle facilities must have the objective of providing high assurance that activities involving SNM would not adversely affect national defense and security or constitute an unacceptable public health and safety hazard. In this context physical security systems are designed to protect against SNM theft or diversion and sabotage. For DOE facility physical security systems, standards for protection of SNM are outlined in DOE Order 5632.2, "Physical Protection of Special Nuclear Materials" (DOE 1979). These standards outline a protection-in-depth concept which is implemented by providing multiple barriers and detection systems between individuals and SNM.

During the first 5 years of CRBRP operation, plutonium for the core fuel would be obtained from DOE stockpiles. The conversion of plutonium to PuO_2 for fabrication of core fuel during the demonstration period would be done either at the Purex Plant on the Hanford Reservation or at another DOE facility having similar processing and safeguards capabilities. Physical security at this type of facility would include provisions for intrusion detection, adversary delay, alarm assessment, alarm response, and normal access control.

At the facility perimeter, two chain-link fences topped with barbed wire would identify the Protected Area boundary. Unauthorized access would be detectable

using an intrusion detection system and a facility access control system. The perimeter would be illuminated, and assessment of alarms could be accomplished by closed-circuit television or security force visual surveillance. The guard station would limit access to the facility to personnel and vehicles necessary to perform facility functions.

All personnel, packages, and vehicles entering or leaving the Protected Area would be subject to search for contraband and plutonium. All personnel entering the Protected Area would be required to have DOE security clearances authorizing access to the facility or would be escorted by security-cleared employees. Further personnel access control would be achieved at the process building and subsequently at the plutonium conversion material access area.* Only facility personnel required for plant operations would be allowed access to these areas. All entrances to the building and material access areas would be monitored by an intrusion detection system.

Barriers at the Protected Area perimeter, building exterior, and interior portals to material access areas would be designed to delay intrusion long enough to provide sufficient time for intrusion situation assessment and alarm response actions.

All alarm and assessment systems would be monitored at a central alarm station, and redundantly monitored at a secondary alarm station located nearby.** All alarm equipment and transmission lines would be failure- and tamper-indicating. Both stations would have redundant communication links to the onsite security response force and to offsite local law enforcement agencies.

E.3.2 Material Control and Accounting System Description

All DOE CRBR fuel cycle facilities would be operated under the material control and accounting (MC&A) requirements given in DOE Order 5630, Parts 1 through 7, "Material Control and Accounting...(DOE 1979-81)" Under these requirements, the facility management would establish a system for the control and accounting of plutonium bearing materials. This would include subsystems for:

- o containment
- o surveillance
- o internal control
- o measurement
- o statistics
- o records and reports
- o inventory certification.

The MC&A system, in conjunction with the physical security system, would provide capabilities to detect and deter the illicit diversion of plutonium and would provide assurance that no diversion has occurred.

Physical inventories would be performed on a bimonthly basis. DOE has stated that the limit of error on a 1-month material balance for facilities of this

*Material access area is defined in 10 CFR 73.2(j).

**DOE requires central and secondary alarm stations at all facilities to be continuously manned.

type should be about 0.5% of throughput, and that the limit of error for a 2-month balance should be a slightly lower percentage of throughput.

Based on the expected plutonium throughput of the conversion facility, the limit of error for the inventory difference would be 1 kg or less for 2-month period. Items, including feed, product and scrap materials, would be stored in a vault and their contents verified by non-destructive analysis as frequently as desired.

Safeguards for the conversion facility would include a prompt accounting system which would allow material balances to be performed as frequently as desired and inventory differences estimated with sufficient accuracy to detect abrupt losses of significant quantities at high confidence levels and to detect small recurring losses before a cumulative loss could reach a significant quantity. The prompt accounting system should be able to detect the diversion of less than 1 kg of plutonium over a period as long as a week.

E.3.3 Costs of Plutonium Conversion Safeguards

DOE has not reported data concerning the cost of plutonium conversion facility safeguards.

E.3.4 NRC Assessment of Plutonium Conversion Safeguards

The safeguards systems proposed by DOE for the plutonium conversion facility meet the assessment criteria described in Section E.1. The physical security system contains features that provide for detection of unauthorized activities and for a reasonable level of deterrence of theft of plutonium, as well as for protection of the facility against sabotage. The proposed MC&A measures, which include prompt accounting as well as systems required by DOE Orders (DOE 1979; DOE 1979-81), should provide reasonable assurance that theft or diversion of a significant quantity of plutonium will be detected in a timely manner. Communication systems would enable onsite and offsite forces to respond in such a fashion as to deter and prevent attempted adversary actions. The safeguards systems at this facility could assure that risks from the design basis threat are no greater than at other currently operating U.S. nuclear facilities handling significant quantities of SNM.

Although no cost data for safeguards at the conversion facility have been provided, it is anticipated that the costs would be comparable to the safeguards costs at other similar DOE facilities. Since the candidate facility for the initial plutonium conversion has already been built for other purposes and is only scheduled for CRBR conversion operations during the 5-year demonstration period, the plutonium conversion safeguards costs attributable to the CRBRP operations would be small compared to the other CRBR fuel cycle costs.

E.4 DOE SAFEGUARDS SYSTEM FOR FUEL FABRICATION FACILITIES

E.4.1 Physical Security System Description

The Fuels and Materials Examination Facility (FMEF), where the CRBRP fuel material would be fabricated into fuel rods, and the Fuel Development Laboratory (308 Building), where the fuel rods would be fabricated into assemblies, are located on the DOE Hanford Reservation. Both facilities would have comparable physical security features as described below.

A Protected Area would be established at the facility perimeter to control personnel and vehicle access. This area would be defined by two chain-link fences topped with barbed wire and would utilize intrusion detection systems to alert the security force to possible intrusion attempts. The perimeter would be sufficiently illuminated to permit effective alarm assessment by both closed-circuit television and security personnel. Normal access to the Protected Area would be gained by DOE security-cleared personnel and escorted visitors through a guard station. All persons, packages, and vehicles entering or leaving the area would be subject to search for contraband and plutonium.

The building portals would be security-hardened and alarmed when not in use. The main building entrance would be controlled to allow only authorized individuals access to the building. Search procedures similar to those performed at the Protected Area perimeter would be in effect.

Plutonium in the facility would be located in Material Access Areas (MAA) where access would be further limited to personnel necessary to perform authorized activities in those areas. At the FMEF the plutonium in process would be contained within the Secure Automated Fabrication (SAF) Line, which would be remotely operated from behind isolation walls that function as a secondary confinement barrier. When an MAA is unoccupied, an intrusion detection system would be activated.

Security alarm and assessment systems would sound in a central alarm station. Redundant alarm annunciation would be provided at a secondary alarm station. All alarm equipment and transmission lines would be failure- and tamper-indicating. Both stations would have redundant communication links with security response forces and local law enforcement agencies. Security for the Hanford Reservation is provided by the Hanford Patrol. Sufficient response personnel with appropriate armament are available to protect the facilities and plutonium against the design-basis threats.

E.4.2 Material Control and Accounting System Description

The CRBRP MOX fuel rod fabrication would consist of a multistep process of preparing mixed-oxide pellets and fabricating them into stainless steel fuel rods. The feed to the process would be high purity PuO_2 and UO_2 powders. The fabrication of MOX fuel rods would be done in the SAF Line, which would be built in the FMEF. The SAF Line and the fuel assembly operations in Building 308 would be operated by the DOE under the MC&A requirements given in DOE Order 5630 (DOE 1979-81). The SAF product rods would be shipped as sealed rods to the 308 Building for assembling into finished fuel assemblies.

Shipments and receipts for the SAF Line would be based on measured quantities. For material of well-known composition transfers within the SAF Line would be based on weight measurements and item identification. Elemental or isotopic analyses would be performed on transfers of scrap and waste materials.

Physical inventories would be performed on a bimonthly basis. DOE estimates that the limit of error on a 1-month inventory difference would be about 0.5% of throughput for a facility of this type, and that the error on the inventory difference for bimonthly inventories should be a slightly lower percentage of throughput. Based on the expected throughput of the fuel fabrication facilities, the limit of error on the inventory difference should be no more than one kilogram per 2-month balance.

The MC&A system for the SAF Line also would employ a prompt accountability system. The entire process would be divided into multiple unit-process accountability areas (UPAA). Plutonium quantities entering and leaving a UPAA would be measured, enabling a material balance to be calculated for each UPAA approximately every 24 hours.

The effectiveness of material control would be further enhanced by the automation of the SAF Line, which eliminates the need for routine direct handling of the plutonium. Access to plutonium can be limited to maintenance work and other nonroutine activities that can be carried out under the surveillance of authorized material custodians.

All significant amounts of plutonium in Building 308 would be in the form of sealed rods. Bimonthly inventories and daily checks for missing rods would be performed as required by DOE Order 5630 (DOE 1979-81).

E.4.3 Costs of Fuel Fabrication Safeguards

The costs of safeguards for fuel fabrication are summed for the FMEF and Building 308, and include costs for physical security and material control and accounting for each facility. A summary of DOE-reported costs is shown below.

DOE Costs for Safeguards-Fuel Fabrication
(FMEF and Building 308)
(in millions of \$)

	Capital Investment	Annual Operating
Physical Security System	\$2.2	\$0.3
Material Control and Accounting	1.6	0.9
Security Force	--(a)	0.8
Total	\$3.8	\$2.0

(a) Information not provided by DOE. However, the staff believes these costs would be negligible by comparison.

E.4.4 NRC Assessment of Fuel Fabrication Safeguards

The safeguards systems proposed by DOE for the FMEF fuel rod fabrication line meet the assessment criteria described in Section E.1. The physical security system would contain features that provide for detection of unauthorized activities, reasonable deterrence of theft of plutonium, and protection of the facility against sabotage. The SAF Line's MC&A system using prompt accounting would contribute to the capability of detecting diversion, and would provide assurance

that diversions have not occurred. Communication of alarm conditions to onsite and offsite forces would provide reasonable assurance that both plutonium theft and sabotage can be prevented. Building 308's safeguards system would provide similar levels of safeguards protection. The proposed safeguards systems at these facilities would assure that risks from the design basis threats would be no greater than those at other currently operating U.S. nuclear facilities handling significant quantities of SNM.

The costs of fuel fabrication safeguards reported by DOE appear to be realistic, and represent a small fraction of the total projected costs of the facilities.

E.5. DOE SAFEGUARDS SYSTEM FOR CRBRP

E.5.1 Physical Security System Description

The CRBRP would be a U.S. government facility constructed, licensed, and operated in accordance with NRC regulations. The applicable regulations for physical security are found in 10 CFR 11, 25, 50, 73, and 95. The CRBRP's design features and physical security measures would be developed to meet the performance objectives and requirements as stated in the 10 CFR 73.20 and 73.55, thus providing protection against both the sabotage and theft design basis threats. According to the CRBRP Preliminary Safety Analyses Report (PSAR) (PMC 1975) the physical security system for the CRBRP would:

- o control entry to the CRBRP and specific areas within the plant,
- o deter penetration of facility barriers by unauthorized persons,
- o detect penetrations should they occur, and
- o apprehend in a timely manner all persons (including insiders) attempting acts which constitute a threat to the plant.

The CRBRP PSAR lists design features that are considered necessary to accomplish the above. These include perimeter security barriers identifying a Protected Area boundary equipped with an intrusion detection system, an isolation zone between perimeter barriers void of all structures and vegetation to facilitate intrusion alarm assessment, and adequate perimeter and building lighting to permit visual surveillance and closed-circuit television alarm assessment. There would also be strict access control at the CRBRP, which would be accomplished by an access control facility at the Protected Area perimeter containing security personnel and equipment to search persons and vehicles for contraband, a minimum number of exterior plant doors with access to security-hardened vital areas and an intrusion detection system for portals used to gain access to vital areas. Personnel access to vital equipment and material access areas would be controlled by an electronic system in accordance with levels of authorization. Intrusion detection devices and access control equipment would annunciate in central alarm stations and redundantly in a secondary alarm station. All alarm equipment and transmission lines would be failure- and tamper-indicating. The security force would provide for routine surveillance, access control, alarm response, situation evaluation and threat neutralization. There would also be a communication system between security officers and the central alarm station and the secondary alarm station with redundant communication links between these stations and local law enforcement agencies.

The CRBRP Physical Security Plan and the Safeguards Contingency Plan, which describe measures that would be used to minimize the potential for sabotage and to protect against theft or diversion, are to be provided later in the licensing process and will be reviewed in detail by the NRC staff. The Security Personnel Training and Qualification Plan following the criteria in 10 CFR 73 Appendix B will also be provided.

E.5.2 Material Control and Accounting System Description

The MC&A system for the proposed CRBRP will meet NRC requirements as described in 10 CFR 70. The material accounting will be based entirely on item control. Records showing receipts, internal transfers, and shipments will be maintained for inventory purposes. All movements of fuel would be monitored and the computerized inventory record would show the location of all fuel assemblies.

Material control would be enhanced by the design of the facility. There would be only a limited number of storage locations for fresh and spent fuel assemblies. After visual inspection upon receipt, the fresh assemblies would be placed in a secure location such as the sodium-filled fuel handling system or the reactor core until irradiation is completed. Then they would be loaded into shielded shipping casks for transport to the reprocessing facility after an appropriate cooling time.

E.5.3 Cost of CRBRP Safeguards

DOE reports the cost of safeguards at the CRBRP as shown below.

DOE Costs of Safeguards - CRBRP
(in millions of \$)

	Capital Investment	Annual Operating
Physical Security System	\$3.86	\$0.17
Material Control and Accounting	0.0*	0.0*
Security Force	0.05	2.1
Total	\$3.91	\$2.27

*DOE's reported fuel management and handling system would provide the necessary MC&A data; thus there will be no incremental cost attributable to safeguards accountability.

E.5.4 NRC Assessment of CRBRP Safeguards

The safeguards system proposed by DOE for the CRBRP must meet all NRC safeguards regulations for operating a nuclear reactor licensed under 10 CFR 50.

The physical security measures described in the CRBRP PSAR are reasonable for fulfilling these regulations and include provisions to detect unauthorized activities and deter theft or sabotage. The material control and accounting provisions described in the CRBRP PSAR meet the intent of the NRC regulations in 10 CFR 70.

The costs of safeguards as reported by DOE appear to be realistic and they are a small fraction of the total cost of the CRBRP.

E.6 DOE SAFEGUARD SYSTEM FOR REPROCESSING

E.6.1 Physical Security System Description

DOE has stated that the most likely alternative for the reprocessing of spent fuel from the CRBRP would be the Developmental Reprocessing Plant (DRP). Multiple barriers would be provided at the DRP to exclude unauthorized individuals. A Protected Area would be defined around the DRP to control personnel, vehicle, and rail access to the area. The boundary would consist of two chain-link fences topped by barbed wire. A guard station would control all traffic entering and exiting the Protected Area. The DRP building itself would provide another barrier since it must be substantially constructed to provide a confinement barrier, radiation shielding, and tornado resistant features (see the DOE ER for additional DRP design information). A limited number of building entrances would be provided, each with access controls to assure that only authorized personnel gain access. Inside the DRP, spent fuel, plutonium processing, and plutonium storage operations would be contained within material access areas (MAA). These areas would also be protected with access control features designed to limit personnel to only those necessary to perform authorized activities. Vital areas containing equipment or materials which protect the health and safety of the public would be controlled in a manner similar to that for MAAs.

Unauthorized penetrations of these barriers would be detectable using multiple intrusion detection systems. At the Protected Area perimeter, electronic devices would be installed to detect any movement and the perimeter would be sufficiently illuminated that closed-circuit television could be used to assess any alarm condition. All persons, packages, and vehicles entering or leaving the Protected Area or the process building would be subject to search for contraband or plutonium. The DRP building entrances, when not in use, would be protected by an intrusion detection system, as would the entrances to MAAs and vital areas. Closed-circuit television, guard force posts and patrols, and supervisory observation would provide surveillance measures to assure that only authorized activities are performed. They would also provide alarm assessment when necessary.

All alarms, assessment systems, and response communications would be coordinated at a central alarm station. Alarm transmission and the computerized alarm monitoring system would be tamper- and failure-indicating to prevent tampering and unauthorized access. Redundant capabilities would exist at a secondary alarm station should the central alarm station be compromised. Both stations would have capabilities for redundant, continuous, and rapid communication with onsite and offsite response forces.

DOE has stated that the DRP would be protected by a dedicated security force selected, trained, and equipped in a manner consistent with requirements established in 10 CFR Part 73, Appendix B. The size of the force would be sufficient to impede and neutralize the design basis threats, and contingency plans for unauthorized acts would be prepared. Response forces would be in communication with offsite local law enforcement agencies who would assist as necessary.

E.6.2 Material Control and Accounting System Description

For purposes of material accounting, the DRP would be divided into six material balance areas (MBAs) for which plutonium balances could be performed periodically. The proposed MBAs are:

- o spent fuel storage pool
- o chemical separations area
- o plutonium nitrate storage area
- o plutonium nitrate conversion area
- o plutonium oxide product storage vault
- o analytical laboratory area

During equilibrium operations, an annual average of approximately 81 fuel and axial blanket, 41 inner blanket and 28 radial blanket assemblies would be received, having a total content of approximately 1000 kg of plutonium. The assemblies would be accounted for as discrete items. The book inventory value would be based on reactor calculations. The first measured value would be available after the assemblies are disassembled and the pellets are dissolved. The measured value would serve as the input accounting measurement. In addition, prompt accounting would be used throughout the facility based on continuous monitoring of the uranium and plutonium contents of process streams and intermediate storage vessels.

The final product of the facility destined for use at the proposed CRBRP would be packaged PuO_2 , and would be measured and temporarily stored in a vault on-site. Most of this ultimately would be shipped to the Hanford Reservation for fabrication into fuel assemblies. Any excess would be stored for future use. Accounting in the vault area would be on an item basis. Substantial passive material control would be achieved by limiting personnel access to any significant quantity of plutonium and through the remote operation and maintenance features of the plant. In addition, the massive shielding and the highly radioactive nature of solutions of plutonium in the chemical separations area would present serious obstacles to diversion or theft of plutonium. Active material control would be applied by use of monitoring systems to detect any unauthorized movement of plutonium from the process or storage areas.

For a yearly material balance, the accounting system limit of error is stated to be in the range of 0.7% of throughput for the DRP. This is equivalent to 7 kg of plutonium per year based on an annual CRBRP discharge rate of 1000 kg of plutonium. For the prompt accounting system, DOE has referenced studies that indicate that 5-day balances in controlled experiments have shown a limit of error of about 2 percent.

E.6.3 Costs of Reprocessing Safeguards

DOE based its safeguards cost estimates for reprocessing on the assumption that CRBRP spent fuel would utilize only a fraction (approximately 8%) of the DRP

capacity. Since the DRP is primarily planned for LMFBR near-term reprocessing applications, and the CRBRP represents the bulk of that work, the staff believes that the staff's CRBRP fuel cycle review should consider all costs of DRP safeguards. The total costs of safeguards (not adjusted for the 8% factor) for the DRP are shown below.

DOE Costs of Safeguards for the DRP
(in millions of \$)

	Capital Investment	Annual Operating
Physical Security System	\$35	\$ 1.5
Material Control and Accounting	15	5.0
Security Force	--(a)	3.5
Total	\$50	\$10

(a) Information not provided by the DOE. However, the staff believes these costs would be negligible by comparison.

E.6.4 NRC Assessment of Reprocessing Safeguards

The proposed DOE facility design is conceptual in nature; hence the safeguards system is also conceptual. However, the concepts and technologies for physical security systems for this type of facility are sufficiently developed to assure that the DRP can be effectively protected. Alarm response capabilities are expected to be incorporated into the safeguards design to deter and prevent design basis threat acts.

The MC&A system for this facility is expected to be designed to assure that plutonium losses or diversion would be detected in a timely manner. To achieve the accountability measurement capability stated by DOE would require a sophisticated MC&A system with a level of performance not yet demonstrated in a large reprocessing plant. However, significant progress in MC&A technology has been made through research and development on reprocessing safeguards. Thus the staff believes that, in the time frame of design and construction of the DRP, the safeguards system, as described by the DOE, can meet the assessment criteria. DOE costs of DRP safeguards appear to be realistic and represent only a small fraction of the total fuel cycle cost.

E.7 DOE SAFEGUARDS SYSTEM FOR WASTE MANAGEMENT

E.7.1 Safeguards Description

Based on level of radioactivity or concentration of SNM, there are two types of radioactive waste generated by the CRBR fuel cycle that may require safeguards. These are (1) high-level waste (HLW), and (2) transuranic (TRU) waste.

The HLW generated by reprocessing spent fuel is to be fixed in a solid matrix and packaged in cylinders for disposal at a Federal repository. A physical security program would be incorporated at the site. This program would include access control, means of detecting unauthorized activities, and a response program to resolve abnormal situations.

TRU wastes generated at the reprocessing and fuel fabrication facilities are to be stored according to existing storage policies and procedures at an existing TRU waste storage site located on the DOE Hanford Reservation until disposal at a Federal repository. The site is isolated and protected from public access, with surveillance maintained by the Hanford Patrol.

E.7.2 NRC Assessment of Safeguards Measures

Protection of the waste generated by the CRBRP fuel cycle would be commensurate with the small amount and low concentration of plutonium involved and the generally low attractiveness of the material as a possible target for sabotage. The protection afforded by interim storage facilities and Federal repository disposal will provide additional assurance that sabotage attempts would not be successful. Attempted theft of stored waste materials is considered improbable due to inaccessibility, high radiation levels, and low concentrations of plutonium involved.

The amount of HLW and TRU waste generated by the CRBRP fuel cycle would be small compared to the total volume of similar waste generated by the nuclear industry. Thus any costs associated with the safeguards for CRBR fuel cycle wastes would be expected to be small by comparison with overall waste safeguards costs for the nuclear power industry.

E.8 TRANSPORTATION SAFEGUARDS

E.8.1 Shipment by Truck

The operation of the CRBRP fuel cycle would require the transportation of radioactive material, including plutonium powders, fresh fuel and radioactive wastes. The DOE Order 5632.2 (DOE 1979) requires that all shipments of two or more kilograms of separated plutonium be made in Safe Secure Transport (SST) vehicles except for movement of materials between Protected Areas on the same DOE site. These DOE onsite movements may be made by SST or other security-approved conventional vehicle escorted by armed security personnel in a vehicle equipped with a two-way radio. Such onsite transportation links for the CRBRP fuel cycle would include movements between the conversion facility (PUREX-200 East Area) and fuel rod fabrication (FMEF-400 Area) for PuO_2 powder, the rod fabrication (FMEF-400 Area) and fuel assembly (Building 308-300 Area) for sealed fuel rods, and the rod fabrication (FMEF) and the waste storage area (Hanford Reservation) for transuranic wastes (TRU).

The SST is equipped with active and passive barriers to protect against theft and sabotage attempts. Trained, equipped, and armed drivers and escorts are provided with a radio communication link to a dispatcher and local law enforcement agencies. Offsite SST plutonium movements would include plutonium from

the DOE storage facilities to the conversion plant, CRBRP fuel assemblies to the CRBRP, and plutonium oxide from the reprocessing facility to the FMEF. Truck shipments of plutonium materials are summarized in Table E.1.

E.8.2 Shipments by Rail

DOE has stated that rail shipments of spent CRBRP fuel and high-level waste (HLW) would be in containers that are designed in accordance with Department of Transportation and NRC regulations. Such transportation activities would include spent fuel shipments from the CRBRP to the reprocessing plant, HLW shipments from the reprocessing plant to a waste storage facility, and HLW shipments from a waste storage facility to a Federal geologic repository.

Spent fuel assemblies and HLW are both thermally hot and highly radioactive, and would be transported and protected in large casks weighing many tons. The casks will be designed for transport on 100-ton capacity flatcars and afford considerable protection against sabotage acts. Escorts would maintain continuous surveillance of the casks and would be provided with communication capability to local law enforcement agencies in case of emergencies. Rail shipments are summarized in Table E.1.

E.8.3 Costs of Transportation Safeguards

The transportation costs attributable to safeguards can be fairly easily separated from general transportation costs. The special shipping containers that contain irradiated materials or wastes are considered fuel cycle costs since they are required due to radiological protection needs. Escorts that accompany the shipments and the necessary communications represent the major transportation safeguards costs. Transportation of spent fuel and spent blanket assemblies will have two escorts and a communication network. The cost per escort is expected to be \$50,000 per year.

DOE has indicated that the SST system, which would be used for highway shipments of fresh materials containing plutonium, is principally intended to provide protection from theft or diversion. Thus, it is considered a part of safeguards costs. Based on DOE information, the system has sufficient additional availability and communication capabilities to accommodate CRBRP transportation requirements. Operating costs for the SST are reported to be \$18,000 per 4000 km (2500-mile) shipment.

Two areas not addressed by DOE that may have a minor effect on transportation safeguards costs are movements of material between facilities on the Hanford Reservation and shipments of HLW from the reprocessing facility to the storage facility. Escorting material on the Hanford Reservation may result in the hiring of an extra guard at an annual cost of about \$50,000. DOE states that HLW would be transported in a similar fashion to spent fuel, which implies that escorts may be used. The annual cost of escorting HLW would be \$21,000, based on the ratio of the number of shipments of spent fuel to HLW. Estimated annual costs of transportation safeguards are summarized in Table E.1.

Table E.1 CRBRP plutonium transportation links and safeguards costs

Transportation Link	Plutonium Form	Transport Mode	Shipments per Year	Safeguards Costs
DOE Storage to Pu Conversion ¹	Storage form	SST	NA ²	NA
Pu Conversion to Rod Fabrication ¹	PuO ₂ powder	SST or Escort	NA	\$ 50,000
Rod Fabrication to Fuel Assembly	MOX pellets in sealed rods	SST or Escort	14	
Fuel Assembly to CRBRP	MOX Fuel assemblies	SST	14	252,000
CRBRP to Reprocessing	Spent Fuel assemblies	Casks-Rail	14	100,000
	Spent Blanket assemblies	Casks-Rail	12	100,000
Reprocessing to Rod Fabrication	PuO ₂ powder	SST	14	252,000
Rod Fabrication to Waste Storage	TRU waste	Truck	5	NA
Reprocessing to Waste Storage	TRU & Metal Scrap	Truck	~24	NA
Reprocessing to Waste Storage	HLW in matrix in canisters	Casks-Rail	3	21,000
TOTAL				\$775,000

¹These links exist only for the 5-year demonstration period.

²Data not available.

E.8.4 NRC Assessment of Transportation Safeguards

The transportation safeguards systems proposed by DOE meet the general assessment criteria described in Section E.1. Use of the SST system for highway shipments of separated plutonium would provide reasonable protection against theft and sabotage, as there would be armed escorts, and the vehicle would be equipped with immobilization features. Unauthorized access to the vehicle would be prevented by following strict loading procedures at the facility, providing carefully selected, specially trained, equipped, and armed couriers and drivers, and including active and passive barriers to protect the cargo. Timely response to theft or diversion and sabotage attempts would be provided by constant communication through a central dispatcher (with a redundant system available), and cooperative efforts of local law enforcement and other Federal agencies.

For the cases where the SST system would not be utilized (transfers around the Hanford Reservation and rail shipments for spent fuel and blanket assemblies and HLW), security-approved vehicles with communications and escorts would be used. The rail casks would be massive enough to provide radiological protection, and would also provide substantial theft and sabotage protection. Armed escorts would provide a further level of assurance, as would the communications system which would permit timely local law enforcement agency response to emergencies.

The costs estimated by DOE for transportation safeguards appear to be realistic and do not represent a major contribution to the CRBRP fuel cycle costs.

E.9 ENVIRONMENTAL IMPACTS OF SAFEGUARDING NORMAL OPERATIONS OF THE CRBRP FUEL CYCLE

The staff believes that the environmental impact of the safeguards measures necessary to minimize the risk of a successful act of theft or sabotage will be negligible. The safeguards systems that DOE proposes to employ for the CRBRP fuel cycle would involve minimal construction beyond that required for the operation of the fuel cycle facilities themselves. No new construction will be required for transportation safeguards. The number of operating personnel required for safeguards and the amount of equipment required for their support would be small compared to the overall personnel and equipment requirements of the CRBRP fuel cycle. The operation of the safeguards systems would not impact the environment beyond the immediate vicinity of the fuel cycle activities.

REFERENCES

- U.S. Atomic Energy Commission (AEC). 1974. Clinch River Breeder Reactor Plant Environmental Report. Docket No. 50-537, Project Management Corp. for U.S. AEC, Washington, D.C.
- U.S. Department of Energy (DOE). 1979. DOE Order 5632.2, Office of Safeguards and Security, Washington, D.C.
- U.S. Department of Energy (DOE). 1979-81. DOE Order 5630, Part 1 through 7, Office of Safeguards and Security, Washington, D.C.
- U.S. Department of Energy (DOE). 1982. Amendment XIV to Environmental Report on Clinch River Breeder Reactor Plant. Docket No. 50-537, Washington, D.C.
- Project Management Corporation (PMC). 1975. Clinch River Breeder Reactor Plant Preliminary Safety Analysis Report (PSAR). NRC Docket No. 50-537.

APPENDIX F

LETTER FROM ERDA RE IN LIEU OF TAX PAYMENTS

No changes have been made to this Appendix.

APPENDIX G

LETTER FROM ERDA RE NEED FOR
SOCIOECONOMIC MONITORING PROGRAM

No changes have been made to this Appendix.

APPENDIX H
DRAFT NPDES PERMIT



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV
345 COURTLAND STREET
ATLANTA, GEORGIA 30365

AUTHORIZATION TO DISCHARGE UNDER THE
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Clean Water Act, as amended,
(33 U.S.C. 1251 et. seq; the "ACT"),

U. S. Department of Energy
Clinch River Breeder Reactor Plant Project Office
P.O. Box U
Oak Ridge, Tennessee 37830

DRAFT

OCT 29 1982

is authorized to discharge from a facility located at

Clinch River Breeder Reactor Plant
near Oak Ridge, Tennessee

NOTE: CHANGES TO THE 6/24/82
DRAFT ARE NOTED BY A BAR IN
THE RIGHT MARGIN. OSN 012 HAS
BEEN ADDED TO ATTACHMENTS B
AND C. ATTACHMENTS D AND E
ARE NEW.

to receiving waters named

Clinch River

in accordance with effluent limitations, monitoring requirements and other
conditions set forth in Parts I, II, and III hereof. The permit consists of
this cover sheet, Part I 11 page(s), Part II 12 page(s), Part III
5 page(s), and Attachments 5.

This permit shall become effective on

This permit and the authorization to discharge shall expire at midnight,

Date Signed

Paul J. Traina
Director
Water Management Division

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PART I
Page I-1
Permit No. TN0028801

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on start of discharge and lasting through expiration the permittee is authorized to discharge from outfall(s) serial number(s) 001 - Common Plant Discharge (includes Sewage Treatment Unit effluents during construction and all plant wastes during operation).

Such discharges shall be limited and monitored by the permittee as specified below:

<u>Effluent characteristic</u>	<u>Discharge Limitations</u>		<u>Monitoring Requirements</u>	
	<u>Daily Avg</u>	<u>Daily Max</u>	<u>Measurement Frequency</u>	<u>Sample Type</u>
Flow - m ³ /Day (MGD)	N/A	N/A	Daily	Calculation
Temperature	See Part III.D.	<u>1/</u>	See Part III.D.	
Additional Monitoring	See Part III.C.		<u>2/</u>	24-hour composite
Total Copper (mg/l)	-	<u>3/</u>	<u>2/</u>	24-hour composite
Total Copper (mg/l)	-	<u>3/</u> , <u>4/</u>	<u>2/</u>	24-hour composite

2-H

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): plant discharge prior to entry into the Clinch River except that total copper shall also be monitored at the edge of the mixing zone. Monitoring shall not be applicable until start of discharges other than OSN 002.

- 1/ The receiving water shall not exceed (1) a maximum water temperature change of 3C'(5.4F') relative to an upstream control point, (2) a maximum temperature of 30.5'C (86.9'F), and (3) a maximum rate of change of 2C' (3.6F') per hour as measured at a depth of five feet or mid-depth which ever is less, outside of a mixing zone as defined in Part III.D.
- 2/ Starting six months after commercial operation date, frequency shall be two per month for the first 12 months and once per month thereafter.
- 3/ Limitation to be provided if necessary to comply with Tennessee Water Quality Standards requirements after submission of data and report required by Parts III.P, Q and/or R.
- 4/ Limitation applicable at the edge of the approved mixing zone (see Part III.D.)

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PART I
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Permit No. TN0028801

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on start of discharge and lasting through expiration the permittee is authorized to discharge from outfall(s) serial number(s) 002 1/ - Sewage Treatment Unit effluents to OSN 001 during construction and operation.

Such discharges shall be limited and monitored by the permittee as specified below:

<u>Effluent characteristic</u>	<u>Discharge Limitations</u>		<u>Monitoring Requirements</u>	
	Other Units (mg/l except as noted)		Measurement Frequency	Sample Type
	<u>Daily Average</u>	<u>Daily Maximum</u>		
Flow - m ³ /Day (MGD)	N/A	<u>2/</u>	5/week	Recorder
BOD ₅	30	60*	3/week	Grab
Total Suspended Solids	30	60*	3/week	Grab
Settleable Solids (ml/l)	1.0	1.0	5/week	Grab
Dissolved Oxygen	See Below		5/week	Grab
Chlorine Residual	N/A	N/A*	5/week	Grab
Fecal Coliform <u>3/</u> (organisms/100 ml)	N/A*	N/A*	3/week	Grab

Effluent shall contain a minimum of 1.0 mg/l of dissolved oxygen at all times.

NOTE: Additional units may be added (or subtracted) provided that each individual unit does not exceed the above limitations or its individual design flow. A process modification may be made during the construction phase to the existing system to allow increased flow; however, all other discharge limitations shall apply. In either case, proper application must be made to EPA and the State of Tennessee prior to institution of any changes.

There shall be not discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Individual Sewage Treatment Unit effluents prior to mixing with any other waste stream.

- 1/ Internal serial number for identification and monitoring purposes.
2/ Flow shall not exceed 49 (0.013) for the smaller unit nor 197 (0.052) for the larger unit.
3/ Geometric Mean

* See attachment D for more stringent requirements.

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PART I
Page I-3
Permit No. TN0028801

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on start of discharge and lasting through expiration the permittee is authorized to discharge from outfall(s) serial number(s) 003 through 008 - Point source runoff from areas of construction and yard drainage to unnamed ditches to the Clinch River. (003, 004 and 006 may also receive dewatering wastes and/or other small sources and 007 may also receive overflow from the Concrete Wash Settling Pond and the Aggregate Washing Settling Pond during abnormal rainfall periods.)

Such discharges shall be limited and monitored by the permittee as specified below:

<u>Effluent characteristic</u>	<u>Discharge Limitations</u>	<u>Monitoring Requirements</u>	
	Instantaneous Maximum	Measurement Frequency	Sample Type
Flow - m ³ /Day (MGD)	N/A	1/week 1/	Grab
Total Suspended Solids (mg/l)	2/	1/week 1/, 3/	Grab
Oil and Grease (mg/l) 5/	55/	1/week 1/, 5/	Grab 5/
Detention Volume	See Below	1/six months	Calculation(s)

The runoff treatment ponds shall be capable of processing the 10-year, 24-hour rainfall event plus all accumulated silt without overflow of the standpipe. Not less than once per six months for the first year, permittee shall ascertain that available settling volume meets this requirement and shall report this finding when submitting Discharge Monitoring Reports. Frequency during subsequent years shall be determined based on assessment of the information for the first year.

Permittee shall maintain or obtain records of rainfall representative of site conditions. All periods of rainfall which exceed the 10-year, 24-hour event or cause discharge from any overflow shall be reported to EPA.

The drain valve on 008 (Quarry Pond) shall be locked at all times with the key placed only in the custody of the Senior Construction Site Representative and/or his supervisors and shall not be provided to his subordinates. In the event that this valve must be opened for maintenance purposes, all reasonable precautions shall be taken to minimize any silt released to the Clinch River. Monitoring shall be 2/day by grab sample with analyses to include TSS, pH and flow.

NOTE: No direct discharge from temporary ponds T1, T2, or T3 is permitted by this Authorization to Discharge (Discharge to OSN 003 through 007 is permitted.). Any direct discharge to waters of the U.S. shall be reported in accordance with requirements of Part II.A.3.b, except that reporting shall be within five days. Monitoring shall be 2/day by grab sample with analyses to include TSS, pH and flow.

CONTINUED

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PART I
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Permit No. TN0028801

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on start of discharge and lasting through expiration the permittee is authorized to discharge from outfall(s) serial number(s) 003 through 008 - Point source runoff from areas of construction and yard drainage to unnamed ditches to the Clinch River. (003, 004 and 006 may also receive dewatering wastes and/or other small sources and 007 may also receive overflow from the Concrete Wash Settling Pond and the Aggregate Washing Settling Pond during abnormal rainfall periods.) Continued

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week 1/, 4/.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): points of discharge from treatment ponds A, B, C, D, E and the quarry pond, respectively, prior to mixing with any other waste stream 3/.

- 1/ Sampling and inspection of the filter and water level shall be conducted at least two times per week during periods when the water level is within 36 inches of the top of the overflow pipe. All periods of overflow shall be reported and representative samples collected and analyzed, with the first sample collected within 12 hours of start of overflow.
- 2/ In the event that effluent concentration exceeds 50 mg/l, permittee shall evaluate system performance to assure that the system is operating as designed and that on-site controls are effective. Permittee shall take appropriate corrective action as required.
- 3/ All periods of discharge from the Concrete Wash and Aggregate Washing Settling Ponds to OSN 007 shall be reported and monitored 1/day for total suspended solids, total dissolved solids and pH on grab samples at the individual Settling Pond discharge points.
- 4/ Applicable to any flow up to the flow resulting from a 24-hour rainfall event with a probable recurrence interval of once in ten years.
- 5/ Applicable to OSN 003 only.

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PART I

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Permit No. TN0028801

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on start of discharge and lasting through expiration the permittee is authorized to discharge from outfall(s) serial number(s) 009 1/ - Waste Water Treatment System effluent to OSN 001 or to the cooling tower system as make-up.

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent characteristic	Discharge Limitations				Monitoring Requirements	
	kg/day (lbs/day)		Other Units (mg/l)		Measurement Frequency	Sample Type
	Daily Avg	Daily Max	Daily Avg	Daily Max		
Flow - m ³ /Day (MGD)	-	-	N/A	N/A	Continuous	Recorder
Total Suspended Solids	20(45)	68(150)	30	100	1/week	Grab
Oil and Grease	10(23)	14(30)	15	20	1/week	Grab

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week on a grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Waste Water Treatment System effluent prior to mixing with any other waste stream.

1/ Internal serial number for identification and monitoring purposes.

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Permit No. TN0028801

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

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During the period beginning on start of discharge and lasting through expiration the permittee is authorized to discharge from outfall(s) serial number(s) 010 1/ - Liquid Radwaste effluent to OCN 001.

Such discharges shall be limited and monitored by the permittee as specified below:

<u>Effluent characteristic</u>	<u>Discharge Limitations</u>				<u>Monitoring Requirements</u>	
	kg/day (lbs/day)		(mg/l) (except as noted)		Measurement Frequency	Sample Type
	Daily Avg	Daily Max	Daily Avg	Daily Max		
Flow - m ³ /Day (MGD)	-	-	N/A	N/A	1/batch	Calculation
Total Suspended Solids	0.05(0.11)	0.27(0.60)	15	20	1/batch	Grab
Oil and Grease	0.05(0.11)	0.27(0.60)	15	20	1/batch	Grab

NOTE: The radioactive component of this discharge is regulated by the U.S. Nuclear Regulatory Commission under the requirements of the Atomic Energy Act and not by the U.S.E.P.A. under the Clean Water Act

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/batch.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): discharge from the radwaste treatment system prior to mixing with any other waste stream.

1/ Internal serial number for identification and monitoring purposes.

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Permit No. TN0028801

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

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During the period beginning on start of discharge and lasting through expiration the permittee is authorized to discharge from outfall(s) serial number(s) 011 1/ - Cooling Tower Blowdown to OSN 001.

Such discharges shall be limited and monitored by the permittee as specified below:

<u>Effluent characteristic</u>	<u>Discharge Limitations</u>			<u>Monitoring Requirements</u>	
	Daily Avg	Daily Max	Inst Max	Measurement Frequency	Sample Type
Flow - m ³ /Day (MGD)	N/A	N/A	-	Continuous	Recorder/Totalizer
Total Residual Chlorine - mg/l	-	-	0.14	Continuous	Recorder
Total Residual Chlorine - mg/l	-	-	0.14	1/week	Multiple Grabs
Temperature - °C(°F)	-	32.8(91)	-	Continuous	Recorder

Discharge of blowdown from the cooling system shall be limited to the minimum discharge of recirculating water necessary for the purpose of discharging materials contained in the process, the further build-up of which would cause concentrations or amounts exceeding limits established by best engineering practice. A report showing how conformance with this requirement will be met, including operational procedures, shall be submitted during the system design stage. Additionally, annual reports shall be submitted along with the first quarterly monitoring report submitted after January 1 of each year. Discharge temperature shall not exceed the lowest temperature of the recirculating cooling water prior to the addition of make-up.

There shall be no discharge of detectable amounts of materials added for corrosion inhibition (including but not limited to zinc, chromium or phosphorus) or any chemicals added which contain any of the 129 priority pollutants.

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored by continuous recorder.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): discharge from the cooling towers prior to mixing with any other waste stream.

1/ Internal serial number for identification and monitoring purposes.

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Permit No. TN0028801

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on start of discharge and lasting through expiration the permittee is authorized to discharge from outfall(s) serial number(s) 012 1/ - Pre-operational and other metal cleaning wastes to OSN 003.

Such discharges shall be limited and monitored by the permittee as specified below:

<u>Effluent characteristic</u>	<u>Discharge Limitations</u>		<u>Monitoring Requirements</u>	
	kg/batch(lbs/batch)	Other Units (mg/l)		
		Daily Avg	Daily Max	Measurement Frequency Sample Type
Flow - m ³ /Day (MGD)	<u>2/</u>	N/A	N/A	1/day Determination(s)
Oil and Grease	<u>2/</u>	15	20	<u>2/</u> Grab
Total Suspended Solids	<u>2/</u>	30	100	<u>2/</u> Composite
Copper, Total	<u>2/</u>	1.0	1.0	<u>2/</u> Composite
Iron, Total	<u>2/</u>	1.0	1.0	<u>2/</u> Composite
Phosphorus as P <u>3/</u>	<u>2/</u>	1.0	1.0	<u>2/</u> Composite
Chemical Oxygen Demand <u>4/</u>	<u>2/</u>	N/A	100	<u>2/</u> Composite

Metal cleaning wastes shall mean any cleaning compounds, rinse waters, or any other waterborne residues derived from cleaning any metal process equipment.

Permittee shall notify EPA and the State of any chemicals proposed for use in metal cleaning operations which have not been previously reported and shall indicate the levels of organics, phosphorous and priority pollutants expected in the discharge from OSN 012. Such notification shall be not less than 90 days prior to use. Additional limitations and/or monitoring may be required after notification.

In the event that any metal cleaning wastes are disposed of either on site or off site, disposal shall be in an environmentally acceptable manner. Details of such disposal shall be submitted to EPA and the State not later than 90 days prior to any such disposal.

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored on representative grab samples.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): discharge from the metal cleaning wastes treatment facility prior to mixing with any other waste stream.

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A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

OCT 29 1982

During the period beginning on start of discharge and lasting through expiration the permittee is authorized to discharge from outfall(s) serial number(s) 012 1/ - Pre-operational and other metal cleaning wastes to OSN 003.
Continued

- 1/ Internal serial number for identification and monitoring purposes.
- 2/ The total quantity of each pollutant discharged shall be reported. In no case shall the quantity discharged exceed the quantity determined by multiplying the volume of the batch of metal cleaning waste generated times the concentrations noted above (i.e., 3.8 kg (8.3 lbs) of iron, copper and phosphorus; 57 kg (125 lbs) of oil and grease; and 114 kg (250 lbs) of total suspended solids per million gallons of metal cleaning waste generated). The permittee shall also report the frequency of measurement used to adequately quantify the pollutants discharged. Total volume of wastewater generated and discharged shall be reported.
- 3/ Applicable to preoperational cleaning wastes and other metal cleaning wastes with high initial concentrations of phosphorus.
- 4/ Applicable to any cleaning operation containing organic acids, chelating compounds or other compounds with high oxygen demand.

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A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on start of intake operation and lasting through expiration the permittee shall monitor serial number(s) 013 1/ - Plant Intake.

<u>Characteristic</u>	<u>Limitations</u>		<u>Monitoring Requirements</u>	
	Daily Average	Daily Maximum	Measurement Frequency	Sample Type
Flow - m ³ /Day (MGD)	N/A	N/A	Continuous	Pump logs
Temperature	N/A	N/A	Continuous	Recorder
Additional Monitoring	See Part III.C.		<u>2/</u>	24-hour Composite

Discharge of intake backwash is permitted without limitation or monitoring requirements.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Plant intake

1/ Serial number assigned for identification and monitoring purposes.

2/ Starting six months after commercial operation date, frequency shall be two per month for the first 12 months and once per month thereafter.

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B. SCHEDULE OF COMPLIANCE

1. The permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with the following schedule:
 - a. Compliance with effluent limitations (001-012) - on start of discharge.
 - b. Blowdown reports (011)
 - (1) Initial report - during system design stage
 - (2) Operating reports - annually with first DMR of each year.
 - c. Metal cleaning waste disposal report (012) - submit 90 days prior to any off site disposal.
 - d. Discharge plume verification (Part III.D.) - submit report by 15 months after commercial operation date.
 - e. Flow evaluation (Part III.E.) - submit report by 15 months after commercial operation date.
 - f. Chlorine minimization (Part III.F.) - submit reports quarterly with DMR's.
 - g. Priority pollutant data (Part III.G.) - submit data by 12 months after commercial operation date.
 - h. Erosion and sedimentation control program (Part III.J.)
 - (1) Implement - on start of construction.
 - (2) Reports -
 - (a) First year - semiannually with first report due on the 28th day of the 8th month after start of construction.
 - (b) After first year - annually
 - i. Striped bass thermal assessment (Part III.M.)
 - (1) Submit report(s) and obtain EPA approval prior to start of discharge construction.
 - j. Preoperational non-radiological monitoring program (Part III.N.)
 - (1) Study plan - submit by six months before implementation
 - (2) Implement - by two years before scheduled fuel loading
 - (3) Reports - annually with first report submitted 15 months after implementation.
 - k. Operational non-radiological monitoring program (Part III.O.)
 - (1) Study plan - submit by six months before implementation
 - (2) Implement - on start of operation
 - (3) Reports - annually with first report submitted 15 months after implementation
 - l. Copper monitoring (Part III.P.)
 - a. Start program - November, 1982
 - b. Final report - January 31, 1984
 - m. Water Quality Standards Compliance (Part III.Q.) - Report January 31, 1984.
 - n. Toxicity Screening (Part III.R.)
 - a. Submit plan - 90 days prior to commercial operation.
 - b. Implement - Subsequent to commercial operation date.
2. No later than 14 calendar days following a date identified in the above schedule of compliance, the permittee shall submit either a report of progress or, in the case of specific actions being required by identified dates, a written notice of compliance or noncompliance. In the latter case, the notice shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

A. MANAGEMENT REQUIREMENTS

1. Discharge Violations

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant more frequently than, or at a level in excess of, that identified and authorized by this permit constitutes a violation of the terms and conditions of this permit. Such a violation may result in the imposition of civil and/or criminal penalties as provided in Section 309 of the Act.

2. Change in Discharge

Any anticipated facility expansions, production increases, or process modifications which will result in new, different, or increased discharges of pollutants must be reported by submission of a new NPDES application at least 180 days prior to commencement of such discharge. Any other activity which would constitute cause for modification or revocation and reissuance of this permit, as described in Part II (B) (4) of this permit, shall be reported to the Permit Issuing Authority.

3. Noncompliance Notification

- a. Instances of noncompliance involving toxic or hazardous pollutants should be reported as outlined in Condition 3c. All other instances of noncompliance should be reported as described in Condition 3b.
- b. If for any reason, the permittee does not comply with or will be unable to comply with any discharge limitation specified in the permit, the permittee shall provide the Permit Issuing Authority with the following information at the time when the next Discharge Monitoring Report is submitted.
 - (1) A description of the discharge and cause of noncompliance;
 - (2) The period of noncompliance, including exact dates and times and/or anticipated time when the discharge will return to compliance; and
 - (3) Steps taken to reduce, eliminate, and prevent recurrence of the noncomplying discharge.

- c. Toxic or hazardous discharges as defined below shall be reported by telephone within 24 hours after permittee becomes aware of the circumstances and followed up with information in writing as set forth in Condition 3b. within 5 days, unless this requirement is otherwise waived by the Permit Issuing Authority:
 - (1) Noncomplying discharges subject to any applicable toxic pollutant effluent standard under Section 307(a) of the Act;
 - (2) Discharges which could constitute a threat to human health, welfare or the environment. These include unusual or extraordinary discharges such as those which could result from bypasses, treatment failure or objectionable substances passing through the treatment plant. These include Section 311 pollutants or pollutants which could cause a threat to public drinking water supplies.
- d. Nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

4. Facilities Operation

All waste collection and treatment facilities shall be operated in a manner consistent with the following:

- a. The facilities shall at all times be maintained in a good working order and operated as efficiently as possible. This includes but is not limited to effective performance based on design facility removals, adequate funding, effective management, adequate operator staffing and training, and adequate laboratory and process controls (including appropriate quality assurance procedures); and
- b. Any maintenance of facilities, which might necessitate unavoidable interruption of operation and degradation of effluent quality, shall be scheduled during noncritical water quality periods and carried out in a manner approved by the Permit Issuing Authority.
- c. The permittee, in order to maintain compliance with this permit shall control production and all discharges upon reduction, loss, or failure of the treatment facility until the facility is restored or an alternative method of treatment is provided.

5. Adverse Impact

The permittee shall take all reasonable steps to minimize any adverse impact to waters of the United States resulting from

noncompliance with any effluent limitations specified in this permit, including such accelerated or additional monitoring as necessary to determine the nature of the noncomplying discharge.

6. Bypassing

"Bypassing" means the intentional diversion of untreated or partially treated wastes to waters of the United States from any portion of a treatment facility. Bypassing of wastewaters is prohibited unless all of the following conditions are met:

- a. The bypass is unavoidable-i.e. required to prevent loss of life, personal injury or severe property damage;
- b. There are no feasible alternatives such as use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment down time;
- c. The permittee reports (via telephone) to the Permit Issuing Authority any unanticipated bypass within 24 hours after becoming aware of it and follows up with written notification in 5 days. Where the necessity of a bypass is known (or should be known) in advance, prior notification shall be submitted to the Permit Issuing Authority for approval at least 10 days beforehand, if possible. All written notifications shall contain information as required in Part II (A)(3)(b); and
- d. The bypass is allowed under conditions determined to be necessary by the Permit Issuing Authority to minimize any adverse effects. The public shall be notified and given an opportunity to comment on bypass incidents of significant duration to the extent feasible.

This requirement is waived where infiltration/inflow analyses are scheduled to be performed as part of an Environmental Protection Agency facilities planning project.

7. Removed Substances

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering waters of the United States.

8. Power Failures

The permittee is responsible for maintaining adequate safeguards to prevent the discharge of untreated or inadequately treated wastes during electrical power failures either by means of alternate power sources, standby generators or retention of inadequately treated effluent. Should the treatment works not include the above capabilities at time of permit issuance, the permittee must furnish within six months to the Permit Issuing Authority, for approval, an implementation schedule for their installation, or documentation demonstrating that such measures are not necessary to prevent discharge of untreated or inadequately treated wastes. Such documentation shall include frequency and duration of power failures and an estimate of retention capacity of untreated effluent.

9. Onshore or Offshore Construction

This permit does not authorize or approve the construction of any onshore or offshore physical structures or facilities or the undertaking of any work in any waters of the United States.

B. RESPONSIBILITIES

1. Right of Entry

The permittee shall allow the Permit Issuing Authority and/or authorized representatives (upon presentation of credentials and such other documents as may be required by law) to:

- a. Enter upon the permittee's premises where an effluent source is located or in which any records are required to be kept under the terms and conditions of this permit;
- b. Have access to and copy at reasonable times any records required to be kept under the terms and conditions of this permit;
- c. Inspect at reasonable times any monitoring equipment or monitoring method required in this permit;
- d. Inspect at reasonable times any collection, treatment, pollution management or discharge facilities required under the permit; or
- e. Sample at reasonable times any discharge of pollutants.

2. Transfer of Ownership or Control

A permit may be transferred to another party under the following conditions:

- a. The permittee notifies the Permit Issuing Authority of the proposed transfer;
- b. A written agreement is submitted to the Permit Issuing Authority containing the specific transfer date and acknowledgement that the existing permittee is responsible for violations up to that date and the new permittee liable thereafter.

Transfers are not effective if, within 30 days of receipt of proposal, the Permit Issuing Authority disagrees and notifies the current permittee and the new permittee of the intent to modify, revoke and reissue, or terminate the permit and to require that a new application be filed.

3. Availability of Reports

Except for data determined to be confidential under Section 308 of the Act, (33 U.S.C. 1318) all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the State water pollution control agency and the Permit Issuing Authority. As required by the Act, effluent data shall not be considered confidential. Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in Section 309 of the Act (33 U.S.C. 1319).

4. Permit Modification

After notice and opportunity for a hearing, this permit may be modified, terminated or revoked for cause (as described in 40 CFR 122.15 et seq) including, but not limited to, the following:

- a. Violation of any terms or conditions of this permit;
- b. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts;
- c. A change in any condition that requires either temporary interruption or elimination of the permitted discharge; or
- d. Information newly acquired by the Agency indicating the discharge poses a threat to human health or welfare.

If the permittee believes that any past or planned activity would be cause for modification or revocation and reissuance under 40 CFR 122.15 et seq, the permittee must report such information to the Permit Issuing Authority. The submission of a new application may be required of the permittee.

5. Toxic Pollutants

- a. Notwithstanding Part II (B)(4) above, if a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the Act for a toxic pollutant which is present in the discharge authorized herein and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, this permit shall be revoked and reissued or modified in accordance with the toxic effluent standard or prohibition and the permittee so notified.
- b. An effluent standard established for a pollutant which is injurious to human health is effective and enforceable by the time set forth in the promulgated standard, even though this permit has not as yet been modified as outlined in Condition 5a.

6. Civil and Criminal Liability

Except as provided in permit conditions on "Bypassing", Part II (A) (6), nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

7. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Act (33 U.S.C. 1321).

8. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Act.

9. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State, or local laws or regulations

10. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

11. Permit Continuation

A new application shall be submitted at least 180 days before the expiration date of this permit. Where EPA is the Permit Issuing Authority, the terms and conditions of this permit are automatically continued in accordance with 40 CFR 122.5, provided that the permittee has submitted a timely and sufficient application for a renewal permit and the Permit Issuing Authority is unable through no fault of the permittee to issue a new permit before the expiration date.

C. MONITORING AND REPORTING

1. Representative Sampling

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge.

2. Reporting

Monitoring results obtained during each calendar month shall be summarized for each month and reported on a Discharge Monitoring Report Form (EPA No. 3320-1). Forms shall be submitted at the end of each calendar quarter and shall be postmarked no later than the 28th day of the month following the end of the quarter. The first report is due by the 28th day of the month following the first full quarter after the effective date of this permit.

Signed copies of these, and all other reports required herein, shall be submitted to the Permit Issuing Authority at the following address(es):

Water Permits Branch
Environmental Protection Agency
Region IV
345 Courtland Street, N.E.
Atlanta, Georgia 30365

3 Test Procedures

Test procedures for the analysis of pollutants shall conform to all regulations published pursuant to Section 304(h) of the Clean Water Act, as amended (40 CFR 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants").

4. Recording of Results

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:

- a. The exact place, date, and time of sampling;
- b. The person(s) who obtained the samples or measurements;
- c. The dates the analyses were performed;
- d. The person(s) who performed the analyses;
- e. The analytical techniques or methods used; and
- f. The results of all required analyses.

5. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Discharge Monitoring Report Form (EPA No. 3320-1). Such increased frequency shall also be indicated.

6. Records Retention

The permittee shall maintain records of all monitoring including: sampling dates and times, sampling methods used, persons obtaining samples or measurements, analyses dates and times, persons performing analyses, and results of analyses and measurements. Records shall be maintained for three years or longer if there is unresolved litigation or if requested by the Permit Issuing Authority.

D. DEFINITIONS

1. Permit Issuing Authority

The Regional Administrator of EPA Region IV or designee.

2. Act

"Act" means the Clean Water Act (formerly referred to as the Federal Water Pollution Control Act) Public Law 92-500, as amended by Public Law 95-217 and Public Law 95-576, 33 U.S.C. 1251 et seq.

3. Mass/Day Measurements

- a. The "average monthly discharge" is defined as the total mass of all daily discharges sampled and/or measured during a calendar month on which daily discharges are sampled and measured, divided by the number of daily discharges sampled and/or measured during such month. It is, therefore, an arithmetic mean found by adding the weights of the pollutant found each day of the month and then dividing this sum by the number of days the tests were reported. This limitation is identified as "Daily Average" or "Monthly Average" in Part I of the permit and the average monthly discharge value is reported in the "Average" column under "Quantity" on the Discharge Monitoring Report (DMR).
- b. The "average weekly discharge" is defined as the total mass of all daily discharges sampled and/or measured during a calendar week on which daily discharges are sampled and/or measured divided by the number of daily discharges sampled and/or measured during such week. It is, therefore, an arithmetic mean found by adding the weights of pollutants found each day of the week and then dividing this sum by the number of days the tests were reported. This limitation is identified as "Weekly Average" in Part I of the permit and the average weekly discharge value is reported in the "Maximum" column under "Quantity" on the DMR.
- c. The "maximum daily discharge" is the total mass (weight) of a pollutant discharged during a calendar day. If only one sample is taken during any calendar day the weight of pollutant

calculated from it is the "maximum daily discharge". This limitation is identified as "Daily Maximum," in Part I of the permit and the highest such value recorded during the reporting period is reported in the "Maximum" column under "Quantity" on the DMR.

4. Concentration Measurements

- a. The "average monthly concentration," other than for fecal coliform bacteria, is the concentration of all daily discharges sampled and/or measured during a calendar month on which daily discharges are sampled and measured divided by the number of daily discharges sampled and/or measured during such month (arithmetic mean of the daily concentration values). The daily concentration value is equal to the concentration of a composite sample or in the case of grab samples is the arithmetic mean (weighted by flow value) of all the samples collected during that calendar day. The average monthly count for fecal coliform bacteria is the geometric mean of the counts for samples collected during a calendar month. This limitation is identified as "Monthly Average" or "Daily Average" under "Other Limits" in Part I of the permit and the average monthly concentration value is reported under the "Average" column under "Quality" on the DMR.
- b. The "average weekly concentration," other than for fecal coliform bacteria, is the concentration of all daily discharges sampled and/or measured during a calendar week on which daily discharges are sampled and measured divided by the number of daily discharges sampled and/or measured during such week (arithmetic mean of the daily concentration values). The daily concentration value is equal to the concentration of a composite sample or in the case of grab samples is the arithmetic mean (weighted by flow value) of all samples collected during that calendar day. The average weekly count for fecal coliform bacteria is the geometric mean of the counts for samples collected during a calendar week. This limitation is identified as "Weekly Average" under "Other Limits" in Part I of the permit and the average weekly concentration value is reported under the "Maximum" column under "Quality" on the DMR.
- c. The "maximum daily concentration" is the concentration of a pollutant discharged during a calendar day. It is identified as "Daily Maximum" under "Other Limits" in Part I of the permit and the highest such value recorded during the reporting period is reported under the "Maximum" column under "Quality" on the DMR.

5. Other Measurements

- a. The effluent flow expressed as M^3/day (MGD) is the 24 hour average flow averaged monthly. It is the arithmetic mean of the total daily flows recorded during the calendar month. Where monitoring requirements for flow are specified in Part I of the permit the flow rate values are reported in the "Average" column under "Quantity" on the DMR.
- b. Where monitoring requirements for pH, dissolved oxygen or fecal coliform are specified in Part I of the permit the values are generally reported in the "Quality or Concentration" column on the DMR.

6. Types of Samples

- a. Composite Sample - A "composite sample" is any of the following:
 - (1) Not less than four influent or effluent portions collected at regular intervals over a period of 8 hours and composited in proportion to flow.
 - (2) Not less than four equal volume influent or effluent portions collected over a period of 8 hours at intervals proportional to the flow.
 - (3) An influent or effluent portion collected continuously over a period of 24 hours at a rate proportional to the flow.
- b. Grab Sample: A "grab sample" is a single influent or effluent portion which is not a composite sample. The sample(s) shall be collected at the period(s) most representative of the total discharge.

7. Calculation of Means

- a. Arithmetic Mean: The arithmetic mean of any set of values is the summation of the individual values divided by the number of individual values.
- b. Geometric Mean: The geometric mean of any set of values is the N^{th} root of the product of the individual values where N is equal to the number of individual values. The geometric mean is equivalent to the antilog of the arithmetic mean of the logarithms of the individual values. For purposes of calculating the geometric mean, values of zero (0) shall be considered to be one (1).

- c. Weighted by Flow Value: Weighted by flow value means the summation of each concentration times its respective flow divided by the summation of the respective flows.

8. Calendar Day

- a. A calendar day is defined as the period from midnight of one day until midnight of the next day. However, for purposes of this permit, any consecutive 24-hour period that reasonably represents the calendar day may be used for sampling.

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OTHER REQUIREMENTS

- A. If the permittee, after monitoring for a least 18 months, determines that he is consistently meeting the effluent limits contained herein, the permittee may request of the Director, Water Management Division that the monitoring requirements be reduced to a lesser frequency or be eliminated.
- B. There shall be no discharge of polychlorinated biphenyl compounds (PCB's) such as those commonly used for transformer fluid. The permittee shall notify EPA of any equipment placed on site which contain PCB's and take appropriate measures to assure that there is no release of PCB's to the environment.
- C. Additional monitoring of the main plant discharge (001) and the plant intake (013) shall be conducted to assure conformance with applicable water quality standards. Parameters shall include ammonia (as N); chloride; sulfate; total hardness; total, dissolved, settleable and suspended solids; dissolved copper; and total cadmium, chromium, copper, iron, lead, mercury, nickel and zinc. Data shall be submitted quarterly with DMR's. After monitoring for at least 12 months, permittee may request of the Director, Water Management Division that the monitoring requirements be reduced to a lesser frequency or be eliminated.
- D. Effluent discharge structure for outfall serial number 001 shall be designed to assure a minimum dilution factor of 14 within 20 meters (66 feet) from the point of discharge for all plant discharge conditions at no-flow reservoir conditions. Subsequent to commercial operation date, field measurements (supplemented as necessary with modeling results) shall be conducted to assure conformance with this requirement and to determine three-dimensional configuration(s) of thermal and chemical plumes. A report showing compliance with the assigned mixing zone shall be submitted by 15 months after the commercial operation date.
- E. Subsequent to the commercial operation date, the permittee shall conduct a detailed evaluation of actual water use and inplant waste discharges to confirm design flow data. A report of this evaluation shall cover a one-year period after startup and shall be submitted not later than 15 months after the commercial operation date. In the event that flow data is significantly different from design data, permit may be modified by the Director, Water Management Division.
- F. Permittee shall implement a program to minimize the discharge of total residual chlorine by the start of cooling tower chlorination. Reduction of makeup and discontinuation of blowdown subsequent to chlorination shall be specifically evaluated. Reports shall be submitted quarterly with DMR's after start of chlorination. At such time as permittee determines that reasonable minimization has been achieved, he may request that this program be eliminated.

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- G. Not more than 12 months after the commercial operation date, permittee shall submit representative data as included in 40 CFR Part 122.53(d)(7)(ii), (iii), and (iv). In the event that any pollutant is present at an unacceptable level, this permit shall be modified, or alternatively, revoked and reissued, to comply with any applicable provisions of the Clean Water Act.
- H. In accordance with Section 306(d) of the Clean Water Act (33 USC Section 1251, et seq.) effluent limitations based on standards of performance contained in this permit shall not be made any more stringent during a ten-year period beginning on the date of completion of such construction or during the period of depreciation or amortization of such facility for the purposes of Section 167 or 169 (or both) of the Internal Revenue Code of 1954, whichever period ends first. The provisions of Section 306(d) do not limit the authority of the Environmental Protection Agency to modify the permit to require compliance with a toxic effluent limitation promulgated under BAT or toxic pollutant standards established under Section 307(a) of the Clean Water Act, or to modify, as necessary, to assure compliance with any applicable state water quality standard. If an applicable standard or limitation is promulgated under Sections 301(b)(2)(C) and (D), 304(b)(2), and 307(a)(2) and that effluent standard or limitation is more stringent than any effluent limitation in this permit or controls a pollutant not limited in this permit, this permit shall be promptly modified or revoked and reissued to conform to that effluent standard or limitation.
- I. The permittee shall notify the Director, Water Management Division and the State Director in writing not later than sixty (60) days prior to instituting use of any additional biocide or chemical in cooling systems, other than chlorine, which may be toxic to aquatic life. Such notification shall include:
1. name and general composition of biocide or chemical,
 2. 96-hour median tolerance limit data for organisms representative of the biota of the waterway into which the discharge shall occur,
 3. quantities to be used,
 4. frequencies of use,
 5. proposed discharge concentrations, and
 6. EPA registration number, if applicable.

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- J. Permittee shall implement the Erosion and Sediment Control Plan as amended by revision 2 dated July 28, 1982. The plan shall be implemented at the commencement of site preparation activities. Consecutive reports shall be submitted covering periods of six months each during the first year of construction. During subsequent years of construction, reports shall be submitted covering 12 month periods. The reports will be due within two months of the end of the reporting period with the first report due by the twenty-eighth day of the eighth month following commencement of construction.
- K. A 25-foot buffer zone will be provided between the Clinch River and the site-preparation activities except in the following areas:
1. The railroad spur going underneath Highway 58, Gallaher Bridge at RR Station 31 + 00 (RM 14.0).
 2. The 48-inch corrugated metal pipe for drainage underneath the railroad spur, RR Station 29 + 39 (RM 14.0).
 3. The 36-inch corrugated metal pipe for drainage underneath the railroad spur, RR Station 50 + 00 (RM 14.25).
 4. The extension of the 6-foot concrete culvert underneath the railroad spur and access road, Rd. Station 1 + 84 (RM 14.5).
 5. The 14-foot corrugated metal pipe underneath the railroad spur and access road, Rd. Station 5 + 35 (RM 14.6).
 6. Road and railroad embankment closer than 25 feet to the Clinch River between Rd. Station 5 + 35 and Rd. Station 19 + 50.
 7. The barge unloading facility (RM 14.75).
 8. The water discharge outfall (RM 16.0).
 9. The water intake (RM 17.9).
 10. The corrugated metal pipe for the quarry treatment pond discharge (RM 18.25).
 11. Where existing River Road and appurtenances are presently closer than 25 feet to the Clinch River.

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- L. When treatment ponds (NPDES 003, 004, 006, 007, and 008) are no longer functionally required, the following steps will be taken:
1. Reestablish natural drainage patterns, and
 2. Restore the area to an acceptable state of natural vegetation.
- M. Permittee shall conduct studies to assure that thermal discharges will have minimal impact on striped bass (*Morone saxatilis*) during extended summer periods of zero flow as described in Section 4.1.2 of the "Update to the CRBRP Alternative Siting Analysis Within the TVA Power Service Area" (dated May 28, 1982).

Permittee shall not start construction of the plant discharge structure prior to submittal of reports on these studies (see Part III.P.) and receiving approval by the Director, Water Management Division to start such construction. Such studies and reports shall include (1) Coordination with TVA studies on lethal temperatures for adult and juvenile striped bass, (2) statistical analysis of streamflow during the months of July through September, (3) reevaluation of the thermal plume dispersion, and if necessary, (4) a review of alternative diffusion designs and thermal modeling. In the event that the above studies fail to demonstrate that the CRBRP thermal discharge will have no significant impact on the striped base thermal refuge, this NPDES permit shall be modified to impose more stringent thermal limitations on plant discharges.

- N. Permittee shall implement an approved preoperational non-radiological aquatic monitoring program to reestablish baseline data on water quality and biotic conditions in the Clinch River not less than two years prior to the scheduled date for fuel loading. Not less than six months prior to the scheduled date for implementation, the permittee shall submit to the Director, Water Management Division, EPA, Region IV, for review and approval, a detailed monitoring plan. Reports shall be submitted annually, not more than three months following completion of the reporting period with the first report due 15 months after implementation of the program. The program shall continue for a period of not less than two years, unless mutually agreed to by EPA and CRBRP.
- O. Permittee shall implement an approved operational non-radiological aquatic monitoring program on the first day of operation. Not less than six months prior to scheduled implementation date, the permittee shall submit to the Director, Water Management Division, EPA, Region IV, for review and approval, a detailed monitoring plan. Reports shall be submitted annually, not more than three months following completion of the reporting period with the first report due 15 months after implementation of the program. The program shall continue for a period of not less than two years, unless mutually agreed to by EPA and CRBRP.

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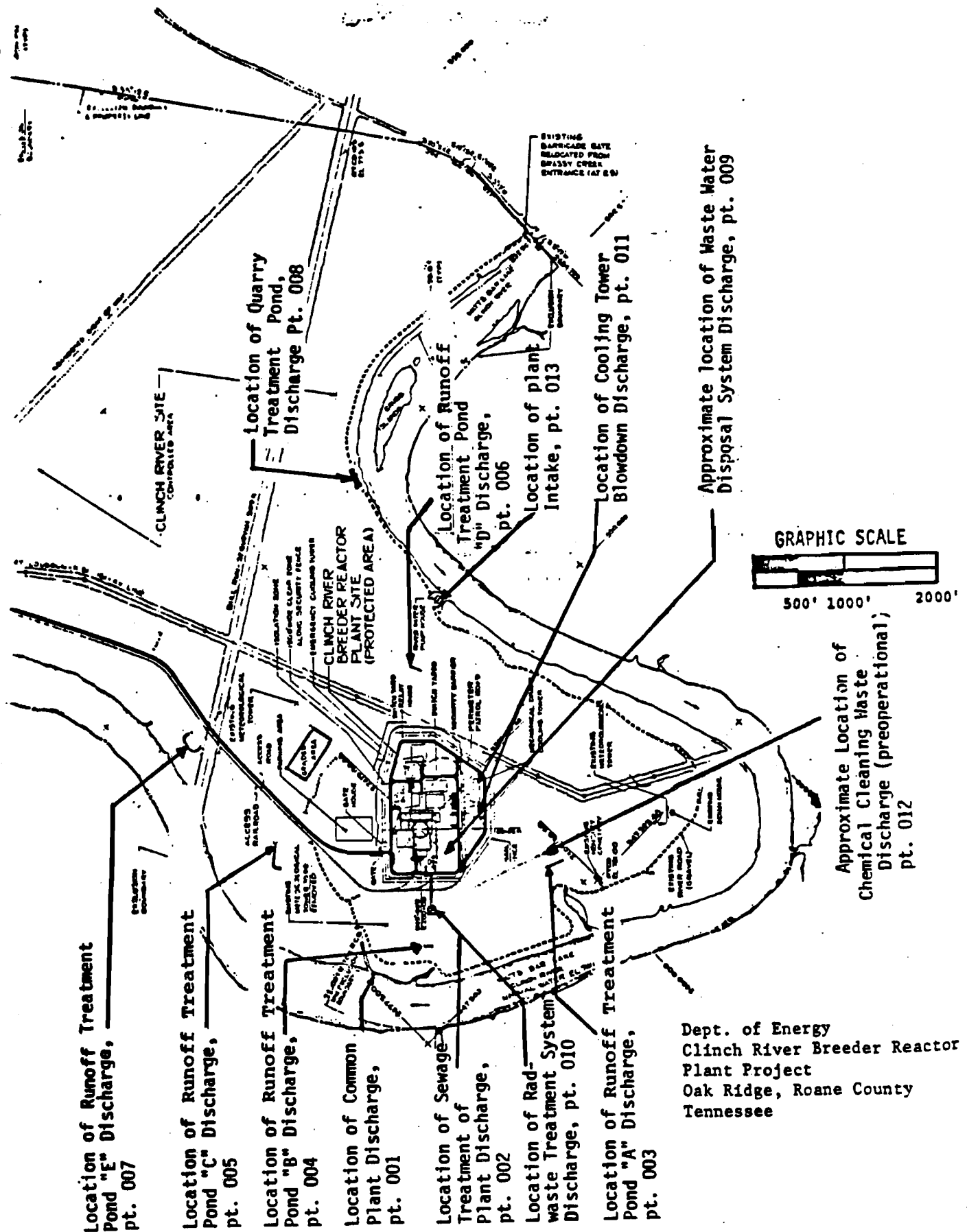
- P. Permittee shall document ambient levels of total and dissolved copper in the Clinch River at the CRBRP Site to assure his ability to comply with permit requirements. Sampling and analysis shall be conducted at a frequency of two per month starting no later than November 1982. Data shall be submitted quarterly under OSN 013 and a summary report shall be submitted in conjunction with Part III.Q. requirements by January 31, 1984. Last samples to be collected in October 1983.
- Q. Not later than January 31, 1984, permittee shall submit a detailed assessment of his ability to comply with permit conditions and Tennessee Water Quality Standards requirements as to effluent and instream concentration limitations and mixing zone size for copper. In the event that permittee can not demonstrate the necessary compliance, the report shall indicate an implementation schedule to assure that compliance will be achieved prior to plant operation.
- R. Subsequent to commercial operation date, permittee shall conduct approved toxicity screening of OSN 001. A study plan shall be submitted for review and approval not later than 90 days prior to commercial operation.
- S. Copies of all plans, assessments, and reports submitted in accordance with Parts III. J, M, N, and O herein shall be forwarded by the permittee as follows:

<u>Number of Copies</u>	<u>Addressee</u>
2	Director, Water Management Division, EPA (Atlanta)
1	Chief, Ecology Branch, EPA (Athens)
2	Director for Environmental Projects, NRC (Washington)
1	Regional Director, Fish and Wildlife Service (Atlanta)
1	Director, Tennessee Division of Water Quality Control (Nashville)
1	Regional Engineer, Tennessee Division of Water Quality Control (Knoxville)

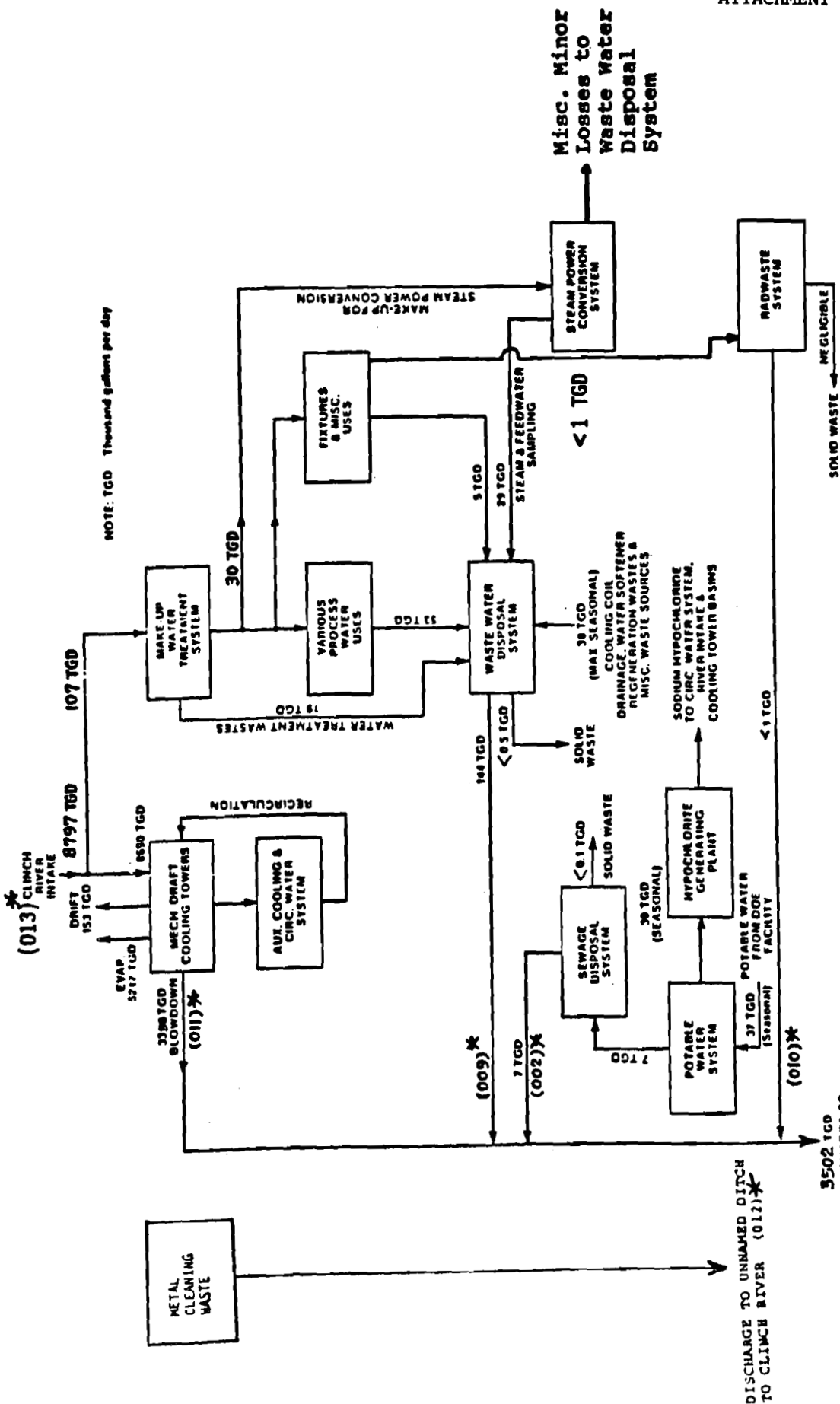
- T. The State of Tennessee has certified the discharge(s) covered by this permit with conditions (see Attachments D and E). Section 401 of the Act requires that conditions of certification shall become a condition of the permit. The monitoring and sampling shall be as indicated for those parameters included in the certification. Any effluent limits, and any additional requirements, specified in the attached State Certification which are more stringent supersede any less stringent effluent limits provided herein. During any time period in which the more stringent State Certification effluent limits are stayed or inoperable, the effluent limits provided herein shall be in effect and fully enforceable. (Note: Certification to be provided prior to permit issuance.)

LOCATION OF DISCHARGE POINTS

Permit No. TN0028801
ATTACHMENT A



SCHEMATIC OF WATER FLOW – OPERATING PERIOD



**Department of Energy
Clinch River Breeder Reactor Plant Project
Oak Ridge, Roane County, Tennessee**

***NPDES Outfall serial number**



TENNESSEE DEPARTMENT OF PUBLIC HEALTH
Environmental Management and Quality Assurance Administration
T.E.R.R.A. BUILDING
150 NINTH AVENUE, NORTH
NASHVILLE, TENNESSEE 37203

July 15, 1982

Mr. Paul J. Traina
Director
Water Management Division, Region IV
Environmental Protection Agency
345 Courtland Street
Atlanta, Georgia 30365

RE: State Certification
NPDES No. TN0028801
Clinch River Breeder Reactor Project
Anderson County

Dear Mr. Traina:

Pursuant to Section 401 of the Federal Water Pollution Control Act (as amended by the Clean Water Act of 1977), 33 U.S.C. 1251, 1341, the State of Tennessee hereby issues certification to the subject applicant for a National Pollutant Discharge Elimination System (NPDES) Permit for a wastewater discharge.

The State of Tennessee is not aware of any condition or limitation under Section 301, Section 302, or Section 303 of the Federal Act that would be violated by issuance of the proposed NPDES Permit; additionally, the State of Tennessee is not aware of any standard of performance under Section 306 or Section 307 that would be violated by issuance of the proposed Permit.

This certification is contingent upon the following conditions:

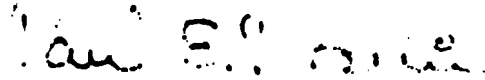
1. Permittee is in no way relieved from any liability for damages which might result from the discharge of wastewater.
2. Permittee must additionally comply with all requirements, conditions, or limitations which may be imposed by any provision of the Tennessee Water Quality Control Act (T.C.A. Sections 70-324 through 70-342) or any regulations promulgated pursuant thereto.
3. The State of Tennessee reserves the right to modify or revoke this certification or to seek revocation or modification of the NPDES Permit issued subject to this certification should the State determine that the wastewater discharge violates the Tennessee Water Quality Control Act, or any applicable Water Quality Criteria, or any rules or regulations which may be promulgated pursuant to the Clean Water Act of 1977, Public Law 95-217.

4. The permittee must comply with the following limitations on Discharge 002, the sewage treatment plant effluent:
 - a. Daily maximum BOD₅ must be 45 mg/l.
 - b. Daily maximum Total Suspended Solids must be 45 mg/l.
 - c. Daily maximum Chlorine Residual must be 2.0 mg/l.
 - d. The wastewater discharge must be disinfected to the extent that viable coliform organisms are effectively eliminated. The concentration of the fecal coliform group after disinfection shall not exceed 200 per 100 ml. as the geometric mean based on a minimum of 10 samples, collected from a given sampling site over a period of not more than 30 consecutive days with individual samples being collected at intervals not less than 12 hours. For the purpose of determining the geometric mean, individual samples having a fecal coliform group concentration of less than one (1) per 100 ml. shall be considered as having a concentration of one (1) per 100 ml. In addition, the concentration of the fecal coliform group in any individual sample shall not exceed 1,000 per 100 ml.
 - e. The waste treatment facilities shall be operated under the supervision of a certified operator in accordance with the Tennessee Public Water and Wastewater Environmental Health Act of 1971.
5. For discharge 003 through 008, the permittee must report to the State and to EPA all periods of rainfall which exceed the 10-year, 24-hour event or cause discharge from any overflow.
6. The permittee must submit to the State for review and approval the following:
 - a. The construction phase erosion and sediment control plan. This plan is to incorporate best available technology for control of erosion and sediment, as well as best management strategy for control of oil and grease and other pollutants from the construction equipment maintenance area. This plan must be approved 90 days before the start of construction.
 - b. The engineering report for the collection, treatment, and discharge of all wastewater. This report must quantify the concentration and total mass of dissolved solids to be released on a daily basis from this facility during commercial operation.
 - c. The construction plans and specifications.

State Certification
July 15, 1982
Page 3

7. The permittee must submit to the State, for review and approval, a plan for toxicity screening of discharge 001. This plan is to be approved no later than 90 days prior to commercial operation.

Very truly yours,



Paul E. Davis
Manager, Permits Section
Division of Water Quality Control

PED/NR/dlr

cc: Percy Brewington, CRBRP Project
Nuclear Regulatory Commission



Permit No. TN0028801
ATTACHMENT E

STATE OF TENNESSEE
DEPARTMENT OF PUBLIC HEALTH
EAST TENNESSEE REGIONAL OFFICE
ALEX B. SHIPLEY REGIONAL HEALTH CENTER
1522 CHEROKEE TRAIL
KNOXVILLE, TENNESSEE 37930
September 21, 1982

CERTIFIED MAIL

Mr. Paul J. Traina
Director
Water Management Division, Region IV
Environmental Protection Agency
345 Courtland Street
Atlanta, Georgia 30365

Re: State Certification
NPDES No. TN0028801
Clinch River Breeder Reactor
Project
Anderson County

Dear Mr. Traina:

The Construction Phase Erosion and Sediment Control Plan called for in Section 6.A. of the State's July 15, 1982 certification of the above referenced permit has been received, reviewed, and approved.

Approval for the ESCP was given at the final plans review meeting on July 27, 1982. As an administrative device no longer required, we are lifting the 90-day clause contained in Section 6.A. of our certification.

If you have questions related to this or other permit activities, do not hesitate to call.

Very truly yours,

Paul E. Davis FDK

Paul E. Davis
Manager, Permits Section
Tennessee Water Quality Control

PED:ADM:bm

cc: Percy Brewington, CRBRP
Nuclear Regulatory Commission

NPDES Permit Rationale
Clinch River Breeder Reactor Plant
Permit No. TN0028801
OCT 29 1982

I. Applicable Regulations

- A. Federal performance standards for new sources: Chemical wastes (40 CFR 423.15) and area runoff (40 CFR 423.45) as promulgated on October 8, 1974, with proposed revisions published on October 14, 1980.
- B. Tennessee Water Quality Standards: Rules of the Tennessee Department of Public Health, Bureau of Environmental Health Services, Division of Water Quality Control, Chapter 1200-4. The Clinch River in this reach has been classified for Domestic and for Industrial Water Supply, Fish and Aquatic Life, Recreation, Irrigation, and Livestock Watering and Wildlife.

II. Effluent Limitations

A. Outfall Serial Number (OSN) 001 - Common Plant Discharge.

- 1. Except for copper as noted below, only monitoring requirements are included since effluent limitations have been applied to individual waste streams which discharge through this OSN.

2. Copper.

- a. Criteria. Criteria for toxic pollutants are provided in Chapter 1200-4-3.01(3)(c)7 of the Rules of the Tennessee Department of Public Health for Fish and Aquatic Life and are as follows:

Toxic Substances - There shall be no substances added whether alone or in combination with other substances that will adversely affect fish or aquatic life. The instream concentrations of toxic pollutant shall not exceed 1/10 of the 96-hour LC₅₀ based upon available data using one or more of the most sensitive organisms significant to the aquatic community of the waters under consideration. Where there are substances that are toxic due to their cumulative characteristics, other limiting concentrations may be specified on a case by case basis within the discharge permit when factually justified and approved by the Commissioner of the Tennessee Department of Public Health. In no event shall the diversity or productivity of biota significant to the aquatic community of the receiving stream be decreased based upon a 96-hour LC₅₀ criterion and the appropriate application factor. References to be used in determining toxicity limitations shall include, but not

limited to: Quality Criteria for Water (Section 304(a) of PL 92-500), Federal Regulations under Section 307 of PL 92-500, and Federal Regulations under Section 1412 of the Public Health Service Act as amended by the Safe Drinking Water Act (PL 93-523). The use of such information should be limited to that part applicable to the aquatic community found within the receiving stream or waters under consideration.

Table 1 compares ambient, expected effluent and LC₅₀ values for specific parameters. Two columns of LC₅₀ data are included in Table 1. One for fathead minnow and a second for other species for which LC₅₀ data is available. Fathead minnow is one of the normal indicator organisms used by EPA and other researchers for toxicity evaluations. LC₅₀ data for representative sensitive fish species have been utilized even though planktonic fish food organisms such as Daphnia may have LC₅₀ values which are lower than the fish species assessed. This was due to two factors. First, fish are mobile and might remain in the vicinity of the discharge for periods long enough for acute toxicity conditions to occur. However, the planktonic fish food organisms float with the current and do not remain in the vicinity of discharge for extended periods. Secondly, instream assessments have been made at the edge of a 20-meter mixing zone where a 13 to one dilution occurs rather than after complete mixing (i.e. more than 100 to one) in the Clinch River.

Data for all parameters in Table 1, with the possible exception of copper, indicate that compliance with the toxic substances clause of the Tennessee Water Quality Standards should be achieved by the plant discharge. To assure this compliance, intake and effluent monitoring are required by Part III.C. for selected parameters subsequent to plant operations.

In the case of copper, however, absolute certainty cannot be assured at this time based on ambient data at Clinch River Mile 17.9. Data at CRM 10.0 indicates an average value for total copper of 5.6 ug/l. If the ambient value of 5.6 exists at the site, assurance of compliance with the toxic substance clause could be made without further consideration. However, ambient data collected at CRM 17.9 indicates an average of 36.5 ug/l. This discrepancy may be due in part to slightly different sampling or analytical methods or factors related to river conditions at the two locations. Even if actual concentrations of total copper at the plant site average 36.5 ug/l, it must be noted that

a reasonable fishery and food chain population presently exists at the site which would be inconsistent with LC₅₀ data available for the indigenous species. This may be due in part to the criteria development procedure. Most LC₅₀ data is developed utilizing soluble copper (cupric ion) which is typical of most industrial dischargers of copper. However, in the case of CRBRP, increased total copper in the plant discharge is primarily due to concentration of background materials by evaporation of pure water in the cooling tower system. This evaporation leaves behind the pollutants which are in the intake water in a concentration of about two and one-half times that in the plant intake. Regeneration of demineralizers likewise returns pollutants which were removed from the intake water in process water treatment. While some very minimal amount of copper may be added due to corrosion and erosion of condenser tubing, sedimentation of river silt and other suspended material containing copper is likely to result in a net decrease in the total pounds per day of copper returned to the River compared to that which is removed from the River by the plant intake. Unlike the soluble copper used in development of toxicity criteria, ambient concentrations of total copper in the River (and returned in the plant discharge) are likely to be in combined form as part of the sediment load or suspended solids which are not readily available to aquatic organisms and are therefore not likely to be as toxic.

- b. Permit limitations. A provision is included in the permit requiring the permittee to comply with the toxic substances clause both in the discharge and at the edge of the mixing zone. However, as noted above, a specific numerical limitation is not provided at this time pending completion of studies noted below.
- c. Special conditions Part III. Due to the presence of ambient data at the site which indicate that copper exceeds or potentially exceeds the toxic substances clause of the Tennessee Water Quality Standards, Special Conditions III.P, III.Q and III.R have been incorporated into the draft NPDES Permit. Parts III.P and Q require that the applicant conduct a sampling and analysis program for both total and dissolved copper and submit an assessment assuring his ability to comply with Tennessee Water Quality Standards requirements. This report will include an assessment of alternatives, remedial actions, and an implementation schedule to provide corrective actions, if necessary, prior to plant operation. Additionally, Part III.R. requires the permittee to conduct approved toxicity

screening tests on the actual plant effluent to assure that Tennessee Water Quality Standards requirements are met. Approval of the testing methods and procedures as well as evaluation of results will be coordinated with the State of Tennessee.

- B. Sewage Treatment Unit Effluents to OSN 001. Limitations are based on Secondary Treatment requirements (40 CFR 133.102) for domestic waste, Tennessee Standards requirements, and best professional judgements. The State of Tennessee has included more stringent requirements as part of its certification (See Attachment D) to the NPDES Permit.
- C. OSN 003 through 008 - Point sources of runoff from areas of construction (including dewatering and other minor wastes) and yard drainage to ditches to the Clinch River. Requirements are based on 423.45 and best professional judgements. Use of runoff collection ponds combined with filtration is considered to be a best management practice for control of site runoff. Equipment maintenance in the Construction Equipment Maintenance Area will result in the generation of waste oil which will be collected in two dry sump collection basins. These basins are to be cleaned of waste oil for disposed offsite. In the event that oil is not collected at an adequate frequency, rainfall could cause overflow to treatment pond A (OSN 003). Sufficient oil discharge to this pond could cause sealing of the filter with significant maintenance problems for the permittee. Administrative procedures to minimize this problem are proposed by the permittee, including frequent inspection and cleanout of the dry pits. An oil and grease limitation and monitoring requirement is included for OSN 003.
- D. OSN 009 - Wastewater Treatment System effluent to OSN 001. Limitations are as required by promulgated and proposed 423.15(c) for low volume wastes.
1. Concentration Limitations: Total suspended solids limitations of 30 mg/l as a 30-day average ("daily average") and 100 mg/l as a 24-hour average ("daily maximum"). Oil and grease limitations are 15 and 20 mg/l as daily average and daily maximum concentrations, respectively.
 2. Quantity limitations: Based on expected monthly summer discharge rate of 125 gallons per minute (gpm). Calculations are based on the following formula:

$$\text{pounds per day} = \text{mg/l} \times \text{MGD} \times 8.345$$

where, 8.345 is the appropriate conversion factor
 $0.454 \text{ pound/day} = 1.0 \text{ kilogram/day (kg/day)}$
 $\text{MGD} = \text{Million gallons per day} = \text{gpm} \times 0.00144.$

- E. OSN 010 - Liquid Radwaste effluent to OSN 001. Limitations are based on best professional judgement. NOTE: THE RADIOACTIVE COMPONENT OF THIS DISCHARGE IS REGULATED BY THE U.S. NUCLEAR REGULATORY COMMISSION UNDER THE REQUIREMENTS OF THE ATOMIC ENERGY ACT AND NOT BY THE U.S.E.P.A. UNDER THE REQUIREMENTS OF THE CLEAN WATER ACT.
1. Concentration limitations: Total suspended solids and oil and grease limitations of 15 and 20 mg/l, respectively, as daily average and daily maximum concentrations.
 2. Quantity limitations: Limitations are based on a 15 mg/l concentration with the following flows:
 - a. Daily Average - 850 gallons per day (one batch every three days).
 - b. Daily Maximum - 4800 gallons per day (two batches in one day).
- F. OSN 011 - Cooling Tower Blowdown to OSN 001. Limitations are based on requirements of promulgated 423.15(i) and (j) and proposed 423.15(j) and (k), Tennessee Standards requirements, and best professional judgement.
- G. OSN 012 - Metal Cleaning Wastes discharged to unnamed ditch to the Clinch River. Applicant presently proposes to dispose of metal cleaning wastes off-site by contractor. The permit requires that any off-site disposal be conducted in an environmentally acceptable manner and that details of such disposal must be submitted to EPA and the State not later than 180 days prior to off-site disposal. Additionally, limitations and monitoring requirements have been included in the Permit to allow the applicant to discharge treated metal cleaning wastes to the Clinch River in the event that on-site treatment is desired. Limitations are as required by promulgated 423.15(f) and proposed 423.15(d), except that best professional judgement limitations for phosphorus and chemical oxygen demand have been included.
- H. OSN 013 - Plant Intake. Monitoring requirements have been included for comparison with discharge parameter concentrations to assure compliance with Tennessee Water Quality Standards criteria. EPA has tentatively determined that the proposed intake design will meet the requirements of Section 316(b) of the Clean Water Act, i.e. "...the location, design, construction and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact". No post-operational biological monitoring is considered necessary for the intake.

III. Proposed Permit Period - 5 years.

The NPDES permit limitations insure compliance with the most stringent requirements of either the promulgated (October 8, 1974) or proposed (October 14, 1980) standards of performance for new sources (40 CFR 423.15). Data in the application and best professional judgements based on information available for other power plants indicates that additional treatment is not likely to be necessary for priority pollutants. However, to assure that this judgement is correct, the permittee will be required to submit priority pollutant data not later than one year after the commercial operation date (NPDES Permit Part III.G.). Additionally, a reopener clause is included in the permit (NPDES Permit Part III.H.) in the event that excessive levels of priority pollutants are subsequently found. Monitoring of selected parameters (including heavy metal priority pollutants) will be required after the plant becomes operational (NPDES Permit Part III.C.) also. Therefore, it is proposed that a full five-year permit be issued.

IV. Comments Received

- A. Ms. Louise Grenflo, Crossville, Tennessee requested a public hearing. The request was not granted by EPA since it was the only request received and did not indicate a "significant degree of public interest" necessitating a public hearing.
- B. Natural Resources Defense Council, Inc., Washington, D.C.. Identical comments were provided to EPA and NRC. EPA responses were provided to NRC and are included in the Final Supplement to the Final Environmental Statement. Part II of this Rationale has also been expanded to respond to NRDC comments.

TABLE 1

CLINCH RIVER BREEDER REACTOR PROJECT

Parameter	Ambient Water Quality Data					LC50(4)			Expected Effluent(17)		Edge of Mixing Zone(19)	
	CRM 10.0(1)		CRM 17.9(2)			Fathead Minnow	Other Species	0.1 x LC50				
	No Obs.	Avg. Value	No Obs.	Avg. Value	Max. Value				Avg.	Max.	Avg.	Max.
Total hardness mg/l	67	108.	0	-	-	-	-	-	-	-	-	-
Arsenic ug/l	61	<3.1	1	<5.0	5	15,600	15,370(5)	1,540	(18)	(18)	<6	-
Cadmium ug/l	62	<1.9	50	<1.0	1	4,500(6)	1,100(7)	110	(18)	(18)	<1	<1
Chromium ug/l	60	<3.8	50	<5.6	27	18,000(8)	26,500(9)	1,800	(18)	(18)	<6	<30
Copper ug/l	62	<5.6	50	<36.4	170	250(10)	266(11)	25	<200	<500	<48(20)	<194(20)
Lead ug/l	63	<10.9	50	<11.2	35	60,000(12)	-	6,000	<26	<84	<12	<39
Nickel ug/l	10	<23.0	50	<50.2	60	15,000(13)	6,300(14)	630	170	190	<59	<70
Zinc ug/l	11	<14.4	49	<24.9(3)	170	8,100(15)	6,800(16)	680	61	300	<28(21)	<179(21)

Footnotes to Table 1

1. Data at Clinch River Mile 10.0 downstream of the Gallaher Bridge is collected by the State of Tennessee. Average includes data points which are less than the limit of detectability as if they were equal to the limit of detectability.
2. Data at Clinch River Mile 17.9 in the vicinity of the CRBRP intake is collected by TVA. Average includes data points which are less than the limit of detectability as if they were equal to the limit of detectability.
3. Average excludes an abnormally high value of 570 ug/l. If this value were included, the average of 50 samples would be 35.8 ug/l.
4. Concentration of test pollutant lethal to 50 percent of the test organisms in 96 hours. Data from Ambient Water Quality for (Parameter), 1980. (EPA 440/5-80-15 through -079). Separate report volumes are available for each pollutant.
5. Bluegill. Range of 15,370 to 17,400.

Footnotes to Table 1 (Continued)

6. Extrapolated value at a hardness of 100 mg/l. Range of 630 to 1050 at a hardness of 20 mg/l. Range of 2,000 to 12,000 at a hardness of 200 mg/l.
7. Adult striped bass at a hardness of 55 mg/l. Bluegill: 1940 at a hardness of 20 mg/l.
8. Extrapolated value at a hardness of 100 mg/l. Range 36,000 to 66,000 at a hardness of 200 mg/l.
9. Striped bass at a hardness of 35 mg/l.
10. Extrapolated value at a hardness of 100 mg/l. Arithmetic average of seven values is 510 at a hardness of 200 mg/l with a range of 430 to 790.
11. Bluntnose minnow: Arithmetic average of eight values with a range of 210 to 340 at a hardness of 200 mg/l. Adult striped bass: 4000 ug/l at a 55 mg/l hardness. Striped bass larvae and fingerlings: 50 to 150 at a 70 mg/l hardness. Bluegill: 1250 at a hardness of 43 mg/l.
12. Extrapolated value at a hardness of 100 mg/l. Value of 7480 at a hardness of 20 mg/l.
13. Extrapolated value at a hardness of 100 mg/l. Value of 5210 at a hardness of 45 mg/l.
14. Striped bass: 6300 at a hardness of 55 mg/l. Bluegill: 5360 at a hardness of 20.
15. Range of 8100 to 25,000 at a hardness of 100 mg/l.
16. Striped bass at a hardness of 55 mg/l.
17. Data from CRBRP Table 3.6-1, revised (FSFES Table A3.2). Most of increases in maximum effluent concentrations are due to concentration of ambient pollutants by evaporation in the cooling tower.
18. None expected to be added. Effluent would be about 2.5 times ambient.
19. Based on ambient data at CRM 17.9, except as noted. A dilution factor of 13 x ambient to one x effluent is utilized (See Permit Part III.D.). Average ambient is used for average conditions and maximum ambient for maximum conditions.
20. If average ambient level of copper at RM 17.9 is used in the calculation, the maximum mixing zone concentration would be about 70 ug/l. If ambient levels at CRM 10.0 are used in the calculations, average mixing zone concentration would be about 14 ug/l and maximum mixing zone concentration would be about 34 ug/l. Maximum ambient value at CRM 10.0 is 24 ug/l. If average ambient level of copper at CRM 10.0 is used in the maximum mixing zone calculation, the concentration would be about 14 ug/l at the edge of the mixing zone.
21. If the abnormally high ambient value of 570 ug/l is included in the calculations, average mixing zone concentration would be about 40 ug/l and maximum mixing zone concentration would be about 631 ug/l.

APPENDIX I

LETTER TO MR. L. W. CAFFEY FROM
MR. RICHARD DENISE, MAY 6, 1986

No changes have been made to this Appendix.

APPENDIX J

ADDENDUM TO SECTION 7.1: PLANT ACCIDENTS INVOLVING RADIOACTIVE MATERIALS

The staff has examined Section 7.1 of the CRBR FES with a view to updating it to reflect any plant-site-feature or regulatory framework changes that have occurred since the FES was issued in February 1977. The staff finds that no plant-site changes have occurred that are significant to accident risk environmental concerns, nor is there significant new information relevant to environmental concerns that bears on the environmental impacts or risks of accidents as reported in the FES. Since the publication of the FES, however, the Commission has issued a Statement of Interim Policy (June 13, 1980) that provides guidance on the considerations to be given to nuclear power plant accidents under NEPA. Among other things, the Commission's statement indicated: "this change in policy is not to be construed as any lack of confidence in conclusions regarding the environmental risks of accidents expressed in any previously issued (Environmental Impact) statements, nor, absent a showing of...special circumstances, as a basis for opening, reopening, or expanding any previous or ongoing proceeding."

The staff in its environmental review of the CRBR application concluded that the CRBRP did constitute a special circumstance that warranted consideration of Class 9 accidents in the Environmental Statement. Because the CRBRP reactor was very different from the conventional light water reactor (LWR) plants for which the safety experience base is much broader, the staff included in the CRBRP FES a discussion of the potential impacts and risks of such accidents. As noted in the Statement of Interim Policy, the fact that the staff has identified this case (CRBRP) as a special circumstance was one of the considerations that led to the promulgation of the June 13, 1980 Statement.

In examining the FES, the staff has considered that the Interim Policy Statement provides guidance for future NEPA reviews, and the staff has concluded that the discussion of accidents in the FES meets the guidance, except for consideration of the risks due to liquid pathways. A discussion of the liquid pathway risks is in Section J.1.2.

J.1.1 DESIGN-BASIS ACCIDENTS

The results of the staff's analyses of the realistic consequences of design-basis accidents were presented in the FES Table 7.2. The reported values appear to the staff to be reasonable. This conclusion is based upon comparison of realistic dose consequences of the CRBRP design-basis accidents with the corresponding doses for some recently evaluated LWRs such as the Comanche Peak, Callaway, and Palo Verde plants, as shown in Table J.1. The CRBRP doses are within the range of dose values of some of the LWRs, and the radiological health effects and the environmental impacts of such postulated accidents would be comparable to those from postulated LWR accidents.

Table J.1 Comparison of 2-hour design-basis accident (Classes 2-8) site boundary doses reported in the CRBRP FES with corresponding doses reported in the environmental statements of some recent LWR operating license reviews

Accident	CRBRP FES (1121 Mwt)	Comanche Peak FES (3411 Mwt)	Callaway FES (3411 Mwt)	Palo Verde FES (3817 Mwt)
Fuel-handling accidents				
Rems thyroid	0.4	2.0	4.0	0.002
Rems whole body	0.5	0.05	1.0	0.07
Large-break LOCA or site suitability source term				
Rems thyroid	1.0	85.0	91.0	8.0
Rems whole body	0.1	1.2	2.2	0.4
Rems lung	0.2	-	-	-
Rems bone*	1.2	-	-	-

*Dose to bone surface calculated with the ICRP-30 dose conversion factor could be a factor of 3 higher.

Although the staff analysis of the design-basis accidents does not treat in detail the probabilities of accident occurrence except as implied in a general way in the development of the accident classification scheme of the previously proposed annex of Appendix D to 10 CFR 50, the estimated doses are so small that in the staff's judgment no unreasonable radiological risk to the public health and safety and to the environment would arise as a result of these design-basis accidents.

Included in this judgment is acknowledgment that accidents of the types represented by those described in FES Table 7.2 for Classes 2-8 have a finite and relatively larger likelihood of occurrence during the operating lifetime of the CRBRP than the occurrence of Class 9 accidents. Furthermore, their consequences are required not to exceed the dose guideline values of 10 CFR 100. An assessment of the adequacy of the engineered safety features and operating requirements to mitigate and limit the consequences of such accidents will be considered in the safety evaluation of the CRBRP. Such considerations at all contemporary LWRs have resulted in a combination of engineered safety features and operating procedures so that the contribution of these accidents to the total risk to the environment is judged to be negligible. The staff will reexamine the radiological risk contribution of the design-basis accidents at both the construction permit stage and the operating license stage of CRBRP, giving consideration

to the probabilities of occurrence of accidents and to their consequences. The purpose of this reexamination at each stage of licensing will be to require that the plant safety and mitigation systems be designed and operated to offset adequately the uncertainties arising from a limited national and international LMFBR operating experience base, and to ensure that the radiological risks of accidents are not greater than those of the LWRs.

J.1.2 EVALUATION OF CLASS 9 ACCIDENTS

The staff has also performed further calculations to provide additional perspective on the risk associated with hypothetical Class 9 accidents at the CRBRP. Presented below is a discussion of the Class 9 accident sequences, estimates of accident probabilities, release of radioactive material to the environment, risks due to the atmospheric and liquid pathway exposures, economic costs of the loss of the facility, the uncertainties in predictions, and conclusions.

(1) Frequencies of Severe Accidents

The Class 9 accident discussed in the FES involved a sequence and release representative of possible core disruptive accidents (CDAs). Additional sequences are included here to provide better perspective regarding the risks of CRBRP severe accidents.

The frequencies of severe (Class 9) accidents at the CRBRP involving potential core disruption and containment failure are related to three phases of such accidents. First, initiation of core disruption must be considered, and this typically requires simultaneous failures of redundant safety systems. Secondly, there are variations in the release to containment that are dependent on the energy associated with core disruption and the nature of the response of the primary coolant boundary. Finally, the potential for containment failure must be considered. The probabilities of such events are discussed below.

• Initiators of Core Disruptive Accidents

Core disruption could be initiated by: (1) failure to adequately cool the fuel as exemplified by a loss of heat sink (LOHS), loss of coolant accident (LOCA), or massive flow blockage; (2) failure to terminate the fission chain reactions when necessary, as exemplified by a failure to scram during a loss of flow event (ULOF) or a transient overpower event (UTOP); and (3) core-wide fuel failures as exemplified by propagation of local fuel faults (FFP).

As discussed on pages 7-2 and 7-7 of the FES, requirements for prevention of severe accidents will be imposed on the CRBRP design to ensure that initiation of core disruptive accidents is made very improbable. Consequently such accidents are not included in the CRBRP design-basis accident spectrum.

LOHS events at the CRBRP would have to involve simultaneous loss of availability of the main condenser-feedwater train, of all three trains of the steam generator-auxiliary heat removal system (SGAHRs), and of both trains of the direct heat removal system (DHRS). The CRBRP SGAHRs system, which is similar in many respects to the steam generator/auxiliary feedwater systems included in

PWR designs, consists of one steam-driven and two electrically driven auxiliary feedwater trains. The DHRS employs a diverse heat removal concept. Although the staff review of these systems is not complete, it is the judgment of the staff that there is sufficient inherent redundancy, diversity, and independence in the SGAHRS and DHRS systems to achieve a core degradation frequency due to LOHS events of less than 10^{-4} per reactor year. This estimate is based on a general consideration of typical achievable PWR auxiliary feedwater system reliabilities, the potential for common cause failures, and the potential for achieving high reliability in final design and operation through an effective reliability program. A significant contributor to the LOHS probability for the CRBRP would be from simultaneous loss of offsite and onsite ac electrical power and the steam-driven auxiliary feedwater train.

Because of the high boiling point of sodium, the CRBRP primary coolant system would operate at significantly lower pressures than LWR primary coolant systems. This reduces the frequency of large ruptures in the primary coolant system. To further ensure that large breaks cannot occur and cause core damage, implementation of preservice and inservice inspection of the primary coolant boundary and a leak detection system will be required. In addition, guard vessels will be included to prevent unacceptable leakage from large portions of the primary coolant system. For these reasons LOCAs are not considered credible (i.e., design-basis) events at CRBRP. The frequency assumed for LOHS adequately bounds the LOCA contributions to core disruption frequency.

The coolant inlet region of the CRBRP core is being designed to prevent large sudden flow blockage such as that which led to extensive damage to two subassemblies in the Enrico Fermi reactor. Multiple inlet ports at different planes with interposed strainers will prevent large pieces of debris from significantly reducing coolant flow to a subassembly module. Although sources of particulate debris in sufficient quantity to produce significant flow blockage have not been mechanistically identified, it may be postulated that this might occur. Such debris would not be expected to be concentrated but rather be distributed rather generally throughout a large region of the core and would be detectable by the core outlet thermocouples if significantly reduced core flow were to result. The frequency assumed for LOHS core degradation sequences adequately bounds the flow blockage contribution to core disruption frequency.

UTOP and ULof events involve simultaneous failure of both of the reactor shutdown systems. Each of these systems will be required to meet the high standards normally applied to LWR shutdown systems. For example, as specified by IEEE Standard 279, each shutdown system will be automatically initiated, will meet the single failure criterion, and will be tested regularly. Each system consists of three independent electrical actuation channels of diverse logic and diverse components. The mechanical portions of the two systems employ diverse mechanisms. Although the staff review of these systems is not complete, it is the judgment of the staff that there are sufficient inherent redundancy, diversity, and independence in the overall shutdown system designs to expect an unavailability of less than 10^{-5} per demand. This estimate is based on a general consideration of LWR shutdown system unavailability rates, ATWS precursors,* potential for

*ATWS precursors are protection system component failures that have occurred at operating reactors that, if coupled with additional failures, could have led to an ATWS event.

common cause failures, and the feasibility of implementing an effective reliability program to achieve high reliability in the final design and in operation. Using the assumption, based on LWR experience, that an average of about 10 transients (requiring scram) might occur per year of operation over the life of the plant, the staff concludes that the combined frequency of degraded core accidents initiated by ULOF and UTOP events is less than 10^{-4} per reactor year.

The CRBRP fuel design will be required to have an inherent capability to prevent rapid propagation of fuel failure from local faults. Systems to detect more slowly developing faults will also be required. Each of these features is considered feasible and in fact has been achieved on fuel designs similar to that of CRBRP. Therefore, the frequency of fuel failure propagation is considered very low. The frequencies attributed to LOHS, UTOP, and ULOF events adequately bound the contribution to core disruption frequency from fuel failure propagation.

In summary, the frequencies of core disruption from LOHS, UTOP, ULOF, LOCA, and FFP events are all considered to be less than 10^{-4} per reactor year. Even when combined, the overall combined probability of these types of events is estimated to have a net frequency of 10^{-4} per reactor year or less. This net frequency does not reflect the variations in response of the primary coolant system that might be associated with the various initiators. Some initiators may result in more severe response than others. This is taken into account as described in the following paragraphs.

Response of the Primary Coolant System

The response of the primary coolant system to core disruption depends on the amount of energy associated with the disruption. Four categories have been identified and are listed here in order of increasing potential threat to containment integrity and increasing release of radioisotopes into containment:

- I. Primary system remains intact; no significant release of radioactive materials to the containment atmosphere.
- II. Primary system initially intact, but later fails due to ineffective long-term decay heat removal (of the order of hours or more). The release of core debris and sodium would be initially into the reactor cavity; eventually radionuclides and sodium would reach the containment atmosphere through the reactor cavity vents, but at a slow rate relative to the initial releases of Categories III and IV below.
- III. Primary system seals experience partial failure due to excessive mechanical and thermal loads. A limited release of core Pu and other actinides, solid fission products, noble gases, and volatile material into the upper containment would occur immediately.*
- IV. Primary system sealing fails open by excessive mechanical and/or thermal loads. A large release of noble gases, volatile material, solid fission

*Note: Longer term release to containment via the reactor cavity and vents would be in Category II.

products, and core Pu and other actinides could occur immediately. Continuous open venting to the upper containment through failed seals is available for subsequently vaporized sodium and radionuclides.*

Most core disruptive accidents are expected to be nonenergetic and to culminate in effects such as described for Categories I and II above.

The applicants have proposed to incorporate features to mitigate the above behavior indicated in Categories II, III, and IV to reduce the probability of subsequent containment failure. These include a filtered vent system to relieve containment pressure, a containment purge system to reduce the potential for hydrogen explosions, fans in the annulus between the steel containment shell and the confinement structure to cool the two structures, and vents to relieve pressure from gases generated behind the reactor cavity cell liners. These provisions are currently under review by the staff.

The Class 9 accident releases described in Categories III and IV correspond to core disruption of sufficient energy, due to recriticality, to cause mechanical damage to the primary coolant system. The staff is reviewing the potential for energetic recriticalities to determine the magnitude of energy release anticipated. If the conclusion of this review is that an energy release beyond primary system capability cannot be precluded, the staff will require that some action be taken (e.g., that the vessel be strengthened or that head restraints and sodium spray deflectors be installed) to prevent early containment failure from missiles or spray fires. The staff believes that the technology exists to design and build such devices; similar devices and/or measures were utilized in the design of the Fermi reactor, as well as in Atomics International's design studies of a 500-MWe LMFBR demonstration plant.

Assuming that a core disruptive accident occurs, the conditional frequencies of event Categories I through IV subsequently occurring are estimated as follows:

Primary System Failure - Category I, II, and III combined: ~ 0.9 per CDA
Primary System Failure - Category IV: ~ 0.1 per CDA

These estimates reflect the lower frequencies expected for core disruption accidents of increasing energetics. Because of the difficulty of estimating separate probabilities for Categories I, II, and III, they are combined; for the risk analysis, they are conservatively treated together as if all were Category III.

Response of Containment

For the purpose of estimating risk given the threats to containment identified above, the following two containment failure modes leading to airborne releases are identified:

*Note: Longer term release to containment via the reactor cavity and vents would be as in Category II.

(A) Failure of Containment Caused by Overpressure

(B) Failure of Containment to Isolate

The frequency and consequences of releases to the ground by basemat penetration are considered to be overshadowed by airborne releases, as discussed under the subsection entitled "(4) Liquid Pathways" below.

The staff will require that the containment annulus cooling and vent/purge systems be designed with sufficient redundancy and quality and be tested and inspected during operation with sufficient frequency so that it can be assumed that their unavailability for anticipated mission times will not exceed 10^{-2} per demand. Such systems will not be needed to prevent overpressure conditions until many hours after initiation of a CDA, and would not be expected to be affected by loss of offsite and emergency onsite power unless such power loss should be a long-term outage. Should the containment systems be required after a temporary loss of all ac power initiating event, failure to recover ac power before containment failure occurs is estimated to have a frequency of about 10^{-2} per demand.

Containment isolation would be an engineered safety feature at the CRBRP. Such systems are designed to high quality standards and with redundancy. An unavailability of less than 10^{-2} per demand is feasible for such systems and is expected to be attained at CRBRP given that implementation of an adequate reliability program would be required.

In summary, the conditional unavailabilities associated with the containment failure modes are as follows:

Containment Failure Mode A (Mitigating System Failure): $\leq 10^{-2}$ per demand

Containment Failure Mode B (Containment Isolation Failure): $\leq 10^{-2}$ per demand.

(2) Release of Radioactive Material

Estimates of the release fractions of the various isotopes that can escape from the CRBRP are made using the isotope groups defined in WASH-1400. As shown in Table J.2, four release classes are considered and releases to the environment are defined for three containment modes:

- Design leakage and filtered venting
- Overpressure failure, Failure Mode A (at about 24 hours)
- Containment isolation failure, Failure Mode B (24-in.-diameter ventilation line)

Releases from the primary system to the RCB can potentially occur either by leaking through the vessel head seals immediately following an energetic CDA or by release from the sodium pool (which forms in the reactor cavity after reactor vessel and guard vessel meltthrough) through the reactor cavity vent system.

Table J.2 CRBR CDA sequence classes

CDA class	Initiation	Primary system failure category ¹	Containment failure mode	Bounding estimate of containment release frequency ² (per reactor year)	Percent of core inventory released to environment ^{3,4}						
					Xe-Kr	I	CS-Rb	Te-Sb	Ba-Sr	Ru ⁵	La ⁶
1	Generic Core Disruption	I, II, III, or IV	None ⁷	10 ⁻⁴	100	0.01	0.01	0.01	0.01	0.001	0.001
2	Generic Core Disruption	II, III, or IV	A (Overpressure)	10 ⁻⁶	100	1.0	1.0	0.6	0.6	0.08	0.08
3	Generic Core Disruption	II or III	B (Containment Isolation)	10 ⁻⁶	100	1.3	1.3	0.8	0.8	0.06	0.06
4	Generic Core Disruption	IV	B (Containment Isolation)	10 ⁻⁷	100	4.0	4.0	1.7	1.7	0.35	0.35

¹For each CDA class, the most severe primary system failure category in that class was conservatively assumed for the calculation of releases to the environment.

²The release frequency was determined by multiplying the sum of the primary system failure category frequencies in that CDA class by the conditional probability of the containment failure mode.

³Background on the isotope groups and release mechanism is presented in Appendix VII of "Reactor Safety Study," WASH-1400, NUREG-75/014, October 1975.

⁴Indicated release percentages do not include decay; decay is accounted for in the consequence calculations.

⁵Includes Ru, Rh, Mo, Tc.

⁶Includes Y, La, Zr, Nb, Ce, Pr, Nd, Np, Pu, Am, Cm.

⁷CDA Class 1 assumes filtered venting as needed to prevent containment failure.

Chemically inert noble gases (Xe-Kr) are not removed from the RCB other than by decay and leakage or filtered venting to the environment. The remaining fission products can be removed from the RCB atmosphere by decay, leakage, filtered venting, and by naturally occurring depleting mechanisms such as:

- Aerosol agglomeration and settling
- Thermophoretic deposition on cooler surfaces
- Plate-out

The fraction of airborne material that leaks to the environment in the long term depends on the ratio of the leakage rate to the total removal (leakage, filtration, decay, and deposition) rate. Removal by aerosol agglomeration and settling, considered the dominant deposition mechanism, is modeled as an exponentially varying time-dependent process.

Primary system sodium would play an important role in removing fission products in CRBRP. First, sodium chemically combines with fission products such as iodine and bromine to form less volatile compounds. Second, sodium is maintained well below its boiling point during normal operation, and thus fission product release to the RCB is retarded by the liquid sodium. Third, sodium vapor, after it becomes airborne, becomes an aerosol. When sodium vapor enters the RCB, for example, a sodium oxide aerosol is formed. Because there are more than 1 million pounds of primary coolant sodium, a dense aerosol (10-100 $\mu\text{g/cc}$) could be airborne in the RCB. The airborne fission products can interact with and essentially respond as sodium oxide aerosols. For the purpose of analysis, therefore, the airborne fission products (less noble gases) are considered to be removed at the same rate as the sodium aerosols.

Referring to Table J.2, the variation in release fractions among isotope groups and CDA classes depends on the magnitude of competing, concomitant, rate processes (leakage from the RCB, release to the RCB, and deposition in the RCB). It should be emphasized that the indicated release fractions do not include removal by decay; this is accounted for in the consequence calculations.

- Leakage From the RCB

Leakage from the RCB considering CDA Class 1 involves design leakage at rates of 10^{-4} to 10^{-5} of the containment atmosphere per hour and filtered venting which is 97% to 99% efficient. In CDA Class 2, approximately 57% of the RCB atmosphere will be released soon after failure by overpressure because the RCB pressure drops from about 2.3 atmospheres (abs) to 1 atmosphere (abs). Thereafter leakage through the RCB breach is about equal to the release rates of fission products and other gases into the RCB (10^{-1} to 10^{-2} of the containment atmosphere per hour). The leakage rate to the environment considering failure of the containment to isolate a ventilation supply or exhaust line (CDA Classes 3 and 4) is estimated to be on the order of 10^{-1} to 10^{-2} of the containment atmosphere per hour, similar to the rates after overpressure failure. Thus, for each release class, the volume of gases released during the estimated 100- to 200-hour period in which the sodium pool boils will be several times the containment volume.

- Release to the RCB

For the purposes of this analysis, head release fractions were selected as indicated in Table J.3.

Table J.3 Head release selected for source term analysis

Primary system failure category	Percent of core inventory* released from the head (%)						
	Xe-Kr	I	Cs-Rb	Te-Sb	Ba-Sr	Ru	La
III	100	3	3	1	1	0.1	0.1
IV	100	30	30	10	10	3	3

*See footnotes to Table J.2.

The fission product inventory remaining in the vessel after the head release constitutes the pool inventory after vessel meltthrough. Pool releases were estimated by considering the relative volatilities of the fission products compared to sodium. Alkali metals such as cesium, for example, boil off at 10 to 20 times the rate of sodium vaporization. Halogens such as iodine form compounds with sodium and, thus, are released from the sodium pool at a slower rate than the sodium. The remaining semivolatiles and solids are released considerably more slowly than sodium. Insignificant amounts of the nonvolatiles (including fuel) are released to the RCB before cavity dryout.

Once the sodium pool has boiled off, the remaining dry debris will increase in temperature and attack the concrete basemat. Additional release of a fraction of the remaining fission products and fuel is then possible and may be exacerbated by sparging effects caused by the release of gases from the concrete during thermal decomposition.

• Deposition in the RCB

Deposition rates for particulate airborne fission products are a function of the particle shape and size as well as concentration. Typical analysis for similar sodium aerosol conditions indicate deposition rates in a single chamber of between 0.5 and 1.0 per hour. Considering leakage rates between 10^{-2} and 10^{-1} per hour, therefore, indicates that between 1% and 20% of the particulate airborne fission products may eventually be released to the environment.* The overpressure failure mode drops the containment pressure to 1 atmosphere, thereby releasing 57% of its atmosphere. Because this release would not occur until about 24 hours after the head release and about 14 hours after pool boiling begins, considerable deposition of the airborne material would occur. The remaining releases after overpressure relief are similar to those occurring after containment isolation failure.

In addition to that in the RCB, further deposition would occur in the reactor cavity and its vent system, in the annulus between the containment and confinement (overpressure failure), and in the ventilation system (containment isolation

*Design leakage rates of 10^{-4} to 10^{-5} per hour correspond to 10^{-3} to 10^{-5} long-term release fractions. Filtered venting is 97% to 99% efficient.

failure). Each of these features presents a tortuous flow path and appreciable surface area enabling condensation, plate out, and settling. The noble gases are conservatively estimated (decay not included) to completely escape to the environment for each CDA class. This is deemed appropriate because no deposition would occur and several exchanges of the RCB atmosphere would occur.

After considering the above factors, releases to the environment for each CDA class were estimated for vessel head releases, pool releases, and dry cavity releases. These three release components for each CDA class were then combined into a single set of releases for input into the consequence model. The results of this analysis are shown in Table J.2.

• Comparison of Accident Sequence Frequencies

The most probable class of CDA accident sequences is that in which containment systems function as designed, CDA Class 1. Releases to the environment would occur because of design leakage and controlled, filtered venting at about 24 hours after CDA initiation. The likelihood of this accident class is estimated to be less than 10^{-4} per reactor year. For comparison, the doses associated with this accident class are not expected to exceed 10 CFR 100 guidelines.* The primary system failure mode is unimportant for this sequence.

The two most probable classes of CDA accident sequences for which the doses are expected to exceed 10 CFR 100 guidelines* are as follows. First, in CDA Class 2, a CDA is initiated (less than 10^{-4} per reactor year), a primary system failure of Category II, III, or IV (combined conditional frequency ~ 1) occurs, and containment failure mode A, containment cooling or vent/purge failure (leading to overpressure failure) at approximately 24 hours (less than 10^{-2} per demand) follows. This class of CDA accident sequences corresponds to the FES Class 9 accident. In the other of these classes, CDA Class 3, a CDA is initiated (less than 10^{-4} per reactor year), a primary system failure of Categories II and III (combined conditional frequency ~ 1) occurs, and containment failure mode B, failure to isolate (less than 10^{-2} per demand) follows. Both of these classes of CDA accident sequences would therefore have an estimated bounding frequency of less than 10^{-6} per reactor year. Furthermore, the frequency of 10^{-6} per reactor year bounds each CDA accident class sufficiently such that the combined frequency of the two classes is estimated to be less than 10^{-6} per reactor year.

A less probable class of CDA sequences for which doses could exceed 10 CFR 100 guidelines, CDA Class 4, would be initiation of a CDA (less than 10^{-4} per year), primary system failure Category IV (about 0.1 per demand), and containment failure mode B, failure to isolate (less than 10^{-2} per demand). The event has an estimated combined frequency of less than 10^{-7} per reactor year.

*The comparison to 10 CFR 100 guidelines is made here on an ad hoc basis to provide perspective regarding the relative severity of the various CDA classes. The 10 CFR 100 guidelines were developed for siting analysis and are often applied in design-basis accident analysis. They were not intended to apply to Class 9 accidents. Throughout this appendix, dose comparisons to 10 CFR 100 guidelines are made on the basis of realistic calculations for CDAs.

These CDA sequence classes correspond to releases to the environment of four different magnitudes, and their probabilities represent an estimate of the frequency of each release mode.

The CDA sequence classes and their releases to the environment are summarized as percentages of the core inventories in Table J.2. Table J.4 gives the inventory of activity of radionuclides in the CRBRP core at the time of shut-down. The first class in Table J.2, which involves no containment failure, is expected to produce doses not exceeding the guidelines of 10 CFR 100. The second class in the table corresponds to the FES Class 9 accident sequence. Although the sequences represented by the third and fourth classes would involve earlier releases than the FES Class 9 accident, it is not expected that they would involve risks (product of probability and consequences) significantly different from the FES Class 9 accident risk.

(3) Atmospheric Pathway Risks

The potential atmospheric pathway radiological consequences of these accidents have been calculated by the consequence model used in the RSS (NUREG-0340) adapted and modified to the CRBRP site. The model used 1 year of site meteorologic data, projected population for the year 2010 extending throughout a radius of 563 km (350 mi) from the site, and habitable land fractions within the 563-km (350-mi) radius. The essential elements of the atmospheric pathways model are shown in schematic form in Figure J.1.

To obtain a probability distribution of consequences, the calculations were performed assuming the occurrence of each accident-release sequence at each of 91 different "start" times throughout a 1-year period. Each calculation utilized the site-specific hourly meteorological data and seasonal information for the time period following each "start" time. The consequence model also contains provisions for incorporating the consequence-reduction benefits of evacuation, relocation, and other protective actions, because early evacuation and relocation of people would considerably reduce the exposure from the radioactive cloud and from the contaminated ground in the wake of the cloud passage. The evacuation model used has been revised from that used in the RSS for better site-specific application. The quantitative characteristics of the evacuation model used for the CRBRP site include conservative estimates of key parameters. These estimates were made by the staff because the applicants' estimates are in a preliminary state of preparation. Included among the key parameters was the assumption of a 12-hour delay in starting evacuation after operator identification of a severe accident.

There normally would be some facilities near a plant--such as schools or hospitals--where special equipment or personnel may be required to effect evacuation, and there may be some people near a site who may choose not to evacuate. Several facilities of this type have been identified near the CRBRP site, such as the Loudon County Memorial Hospital, Roane County High School, and facilities related to national security. Therefore, actual evacuation effectiveness could be greater or less than that characterized but would not be expected to be significantly less.

Table J.4 Activity of radionuclides in the CRBR reactor core at 1121 MWt

Group/radionuclide	Radioactive inventory in millions of curies	Half-life (days)
A. <u>NOBLE GASES</u>		
Krypton-85	0.1	3,950
Krypton-85m	5.0	0.183
Krypton-87	8.0	0.0528
Krypton-88	11.4	0.117
Xenon-133	52.3	5.28
Xenon-135	56.5	0.384
B. <u>IODINES</u>		
Iodine-131	30.0	8.05
Iodine-132	40.8	0.0958
Iodine-133	51.5	0.875
Iodine-134	54.7	0.0366
Iodine-135	50.4	0.280
C. <u>ALKALI METALS</u>		
Rubidium-86	0.14	18.7
Cesium-135	0.66	750
Cesium-136	2.7	13.0
Cesium-137	1.7	11,000
Sodium-24*	17.4	0.63
D. <u>TELLURIUM-ANTIMONY</u>		
Tellurium-127	3.7	0.391
Tellurium-127m	0.54	109
Tellurium-129	9.7	0.048
Tellurium-129m	2.7	34.0
Tellurium-131m	4.5	1.25
Tellurium-132	40.0	3.25
E. <u>ALKALI EARTHS</u>		
Strontium-89	16.0	52.1
Strontium-90	0.7	11,030
Strontium-91	21.0	0.403
Barium-140	42.0	12.8
F. <u>NOBLE METALS</u>		
Molybdenum-99	46.6	2.8
Technetium-99a	40.3	0.25
Ruthenium-103	52.6	39.5

*Sodium-24 (in the coolant) was represented by cesium-136 in the consequence analysis using the CRAC code.

Table J.4 (Continued)

Group/radionuclide	Radioactive inventory in millions of curies	Half-life (days)
F. <u>NOBLE METALS (Continued)</u>		
Ruthenium-105	38.5	0.185
Ruthenium-106	19.6	366
Rhodium-105	38.5	1.50
G. <u>RARE EARTHS, REFRACTORY OXIDES, AND TRANSURANICS</u>		
Yttrium-90	0.71	2.67
Yttrium-91	20.4	59.0
Zirconium-95	36.2	65.2
Zirconium-97	40.9	0.71
Niobium-95	34.8	35.0
Lanthanum-140	42.2	1.67
Cerium-141	42.9	32.3
Cerium-143	34.8	1.38
Cerium-144	20.2	284
Praseodymium-143	34.8	13.7
Neodymium-147	17.0	11.1
Neptunium-239	1100	2.35
Plutonium-238	0.38	32,500
Plutonium-239	0.11	8,900,000
Plutonium-240	0.10	2,400,000
Plutonium-241	13.0	5,350
Americium-241	0.16	150,000
Curium-242	14.0	163
Curium-244	0.01	6,630

Note: The above grouping of radionuclides corresponds to that in Table J.2.

The other protective actions include: (1) either complete denial of use (interdiction), or permitting use only at a sufficiently later time after appropriate decontamination of foodstuffs such as crops and milk, (2) decontamination of severely contaminated environment (land and property) when it is considered to be economically feasible to lower the levels of contamination to protective action guide (PAG) levels, and (3) denial of use (interdiction) of severely contaminated land and property for varying periods of time until the contamination levels are reduced by radioactive decay and weathering so that land and property can be economically decontaminated, as in (2) above. These actions would reduce the radiological exposure to people from immediate and/or subsequent use of or living in the contaminated environment.

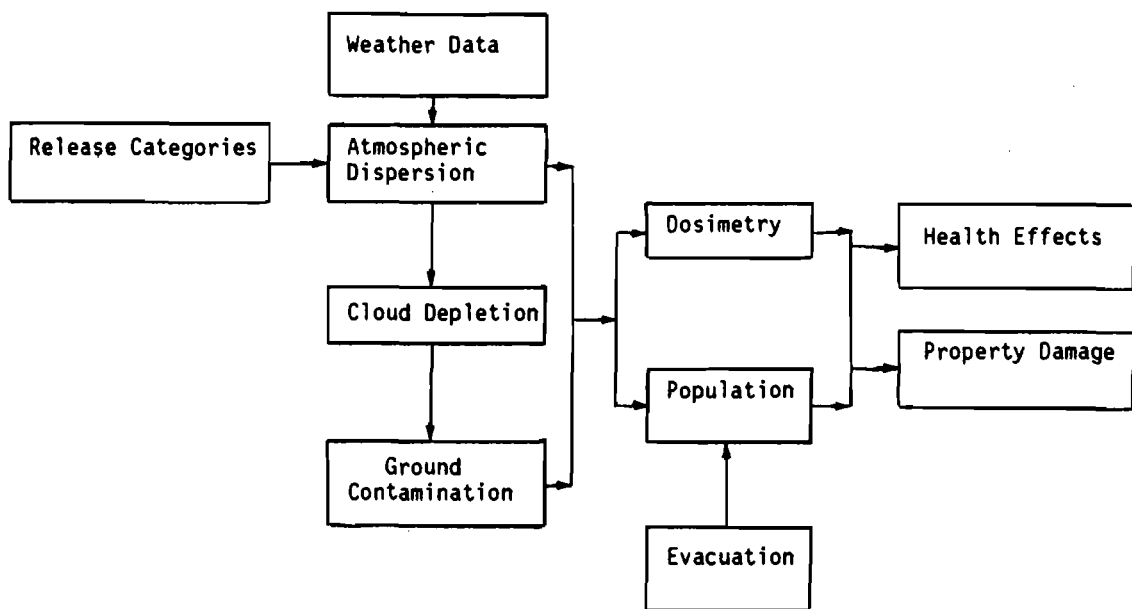


Figure J.1 Schematic outline of atmospheric pathway consequence model

Early evacuation of people from the plume exposure pathway zone (EPZ) and other protective actions as mentioned above are considered essential sequels to severe nuclear reactor accidents involving significant release of radioactivity to the atmosphere. Therefore, the results shown for CRBRP include the benefits of these protective actions.

There are uncertainties in each facet of the estimates of consequences (see Figure J.1) and the error bounds may be as large as they are for accident probabilities. The results of the calculations, based on conservative assumption of a 12-hour delay in evacuation, are summarized and compared with those for the Midland plant (LWR) in Table J.5 as expectation values, or averages of environmental risk per year of reactor operation. These averages are instructive as an aid in the comparison of radiological risks associated with potential CRBRP accidents and those risks calculated for recently evaluated LWRs (such as Midland) for which calculations of radiological risks were made in essentially the same manner. The table shows the average risk associated with population dose, early fatalities, latent fatalities, and costs of protective actions and decontamination.

Table J.5 A comparison of average values of environmental risks due to selected CRBRP accidents with those for the Midland plant

Environmental risk (per reactor year)	CRBRP (1121 MWt)	Midland (2552 MWt)
Population exposure		
Person-remS within 80 km	3.9	26
Total person-remS	5.5	130
Early fatalities	6.7×10^{-6}	1.5×10^{-5}
Latent cancer fatalities		
All organs excluding thyroid	0.3×10^{-3}	7.2×10^{-3}
Thyroid only	0.04×10^{-3}	1.8×10^{-3}
Cost of protective actions and decontamination	\$690*	\$4,800*

*1980 dollars

The population doses and latent fatality risks may be compared with the population doses for normal operation given in Table 5.13 of the FES. The comparison shows that the accident risks are comparable to operating risks.

For perspective and understanding of the meaning of the early fatality risks, 6.7×10^{-6} early fatalities per reactor-year total for all the population, the staff notes that to a good approximation the population at risk within about 16 km (10 miles) of the plant is expected to be about 80,000 persons in the

year 2010. Accidental fatalities per year for a population of this size, based upon overall averages for the United States,* are approximately 18 from motor vehicle accidents, 6.2 from falls, 2.5 from drowning, 2.3 from burns, and 1.0 from fire arms.

In particular, the presence of the large quantity of sodium as the CRBRP coolant would significantly affect the behavior of the radionuclides released from the CRBRP core. A large quantity of sodium chemically and physically combined with the radionuclides released from the core would contribute to agglomeration and settling of the radionuclides in the containment, thereby reducing the fractions of radionuclides released to the atmosphere. On the other hand, the sodium activation products would also be released to the atmosphere along with the core and structural radionuclides. This contribution of sodium to the atmospheric release of radionuclides, and hence to the radiological risks of postulated severe CRBRP accidents, has been considered.

The CRAC consequence model used by the staff does not, at present, account for the consequences of sodium-24. In lieu of Code modifications, the staff has, therefore, used a surrogate from the list of nuclides presented in Table J.4 to represent the radioactivity of sodium-24. A comparison of the dose conversion factors of sodium-24 with those of the other alkali metals in Table J.4 showed a good comparison between the radiotoxicity of sodium-24 and cesium-136. Accordingly, the consequence analysis has been revised by increasing the cesium-136 source inventory by the amount equivalent to sodium-24 in the CRBRP coolant. The results of this analysis indicate that the radioactive sodium release does not significantly increase the calculated consequences of accidents and, therefore, does not increase the risk arising from CRBRP accidents. The aerosol agglomeration effects of sodium, however, are expected to reduce the quantity of radionuclides released to the environs in an accident involving sodium release. Table J.5 summarizes the expectation values (point estimates) of risk calculated for the CRBRP plant.

In addition to the average values of the annual risks summarized in Table J.5, the distribution of the probability of the impacts of early fatalities, latent fatalities, and economic costs, as calculated with the CRAC code, are also presented in Figures J.2, J.3, and J.4 to give an added probabilistic perspective of the CRBRP risks.

Figure J.2 shows the probability distributions for early fatalities representing radiation injuries that would result in fatalities within about 1 year after the exposure. The relatively flat shape of the curve for $X < 10$ indicates that if one person were to receive a lethal dose as a result of a severe accident, there is an approximately equal likelihood that about 10 persons would also receive such a lethal dose. The probability of substantially more than 10 fatalities, however, drops by orders of magnitude, and the staff calculates an exceedingly low probability of 1 chance in 10 billion per year of 30 or more fatalities.

*Based on risk to individual in "CONAES Final Report," National Research Council, Chapter 9, pp. 577-534, 1979.

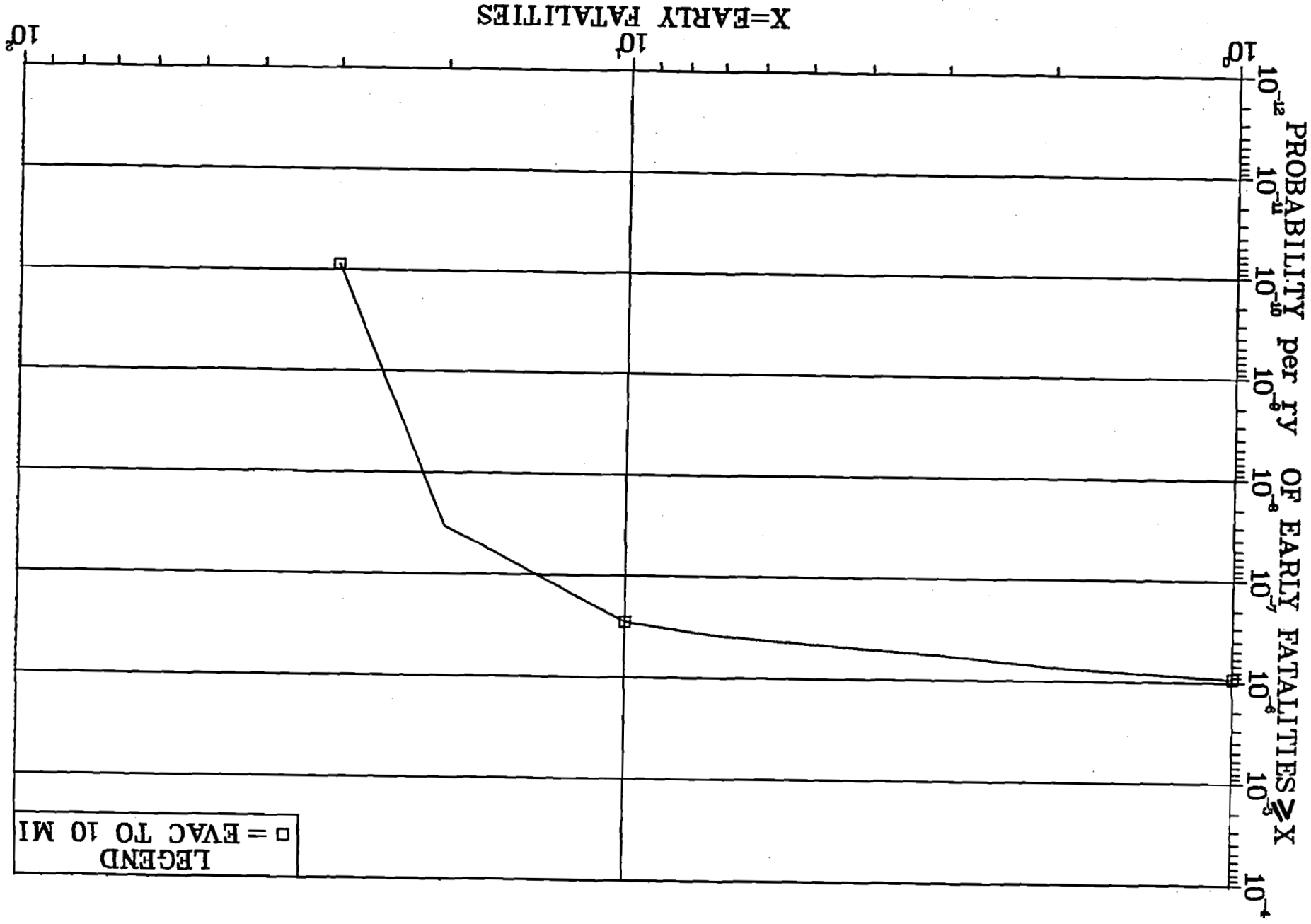


Figure J.2 Complementary Cumulative Distribution Function (CCDF) for Early Fatalities

NOTES: 1. See Section J.1.2(6) for discussion of uncertainties in risk estimates.

2. Results include the consideration of radioactive sodium.

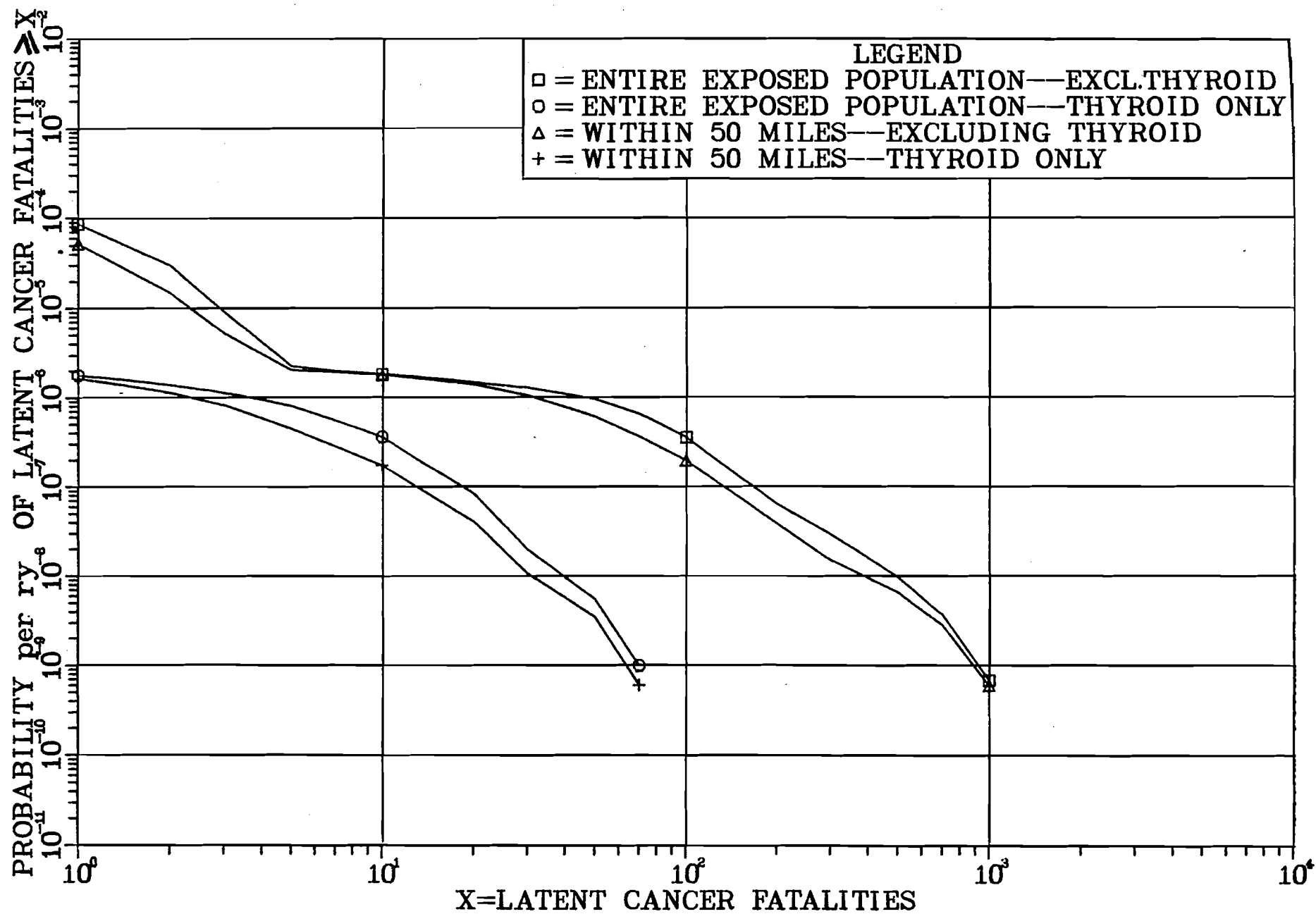


Figure J.3 Complementary Cumulative Distribution Functions (CCDFs) for Cancer Fatalities

- NOTES: 1. See Section J.1.2(6) for discussion of uncertainties in risk estimates.
 2. Results include the consideration of radioactive sodium.

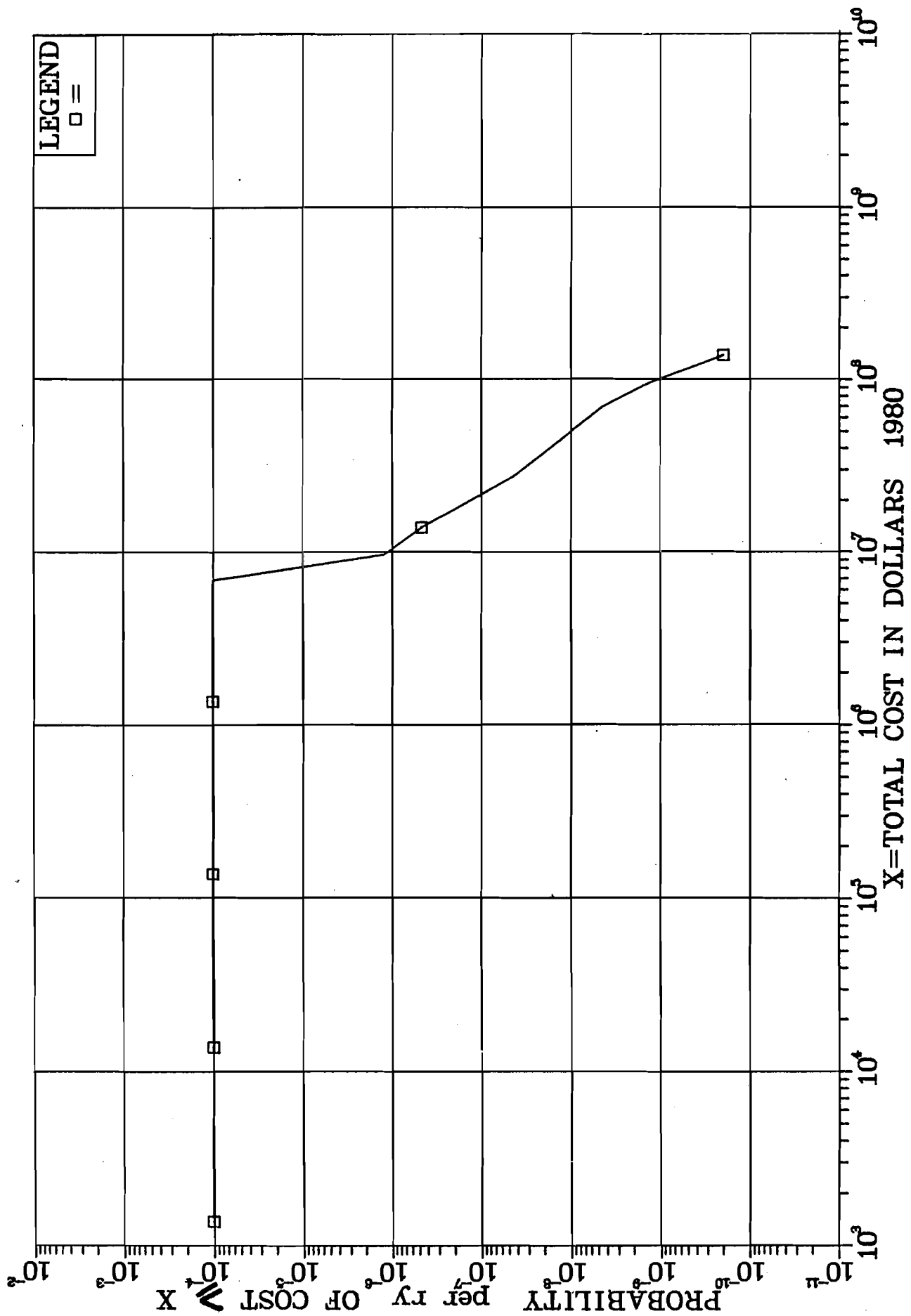


Figure J.4 Complementary Cumulative Distribution Function (CCDF) for Mitigation Measures Cost

NOTES: 1. See Section J.1.2(6) for discussion of uncertainties in risk estimates.

2. Results include the consideration of radioactive sodium.

Figure J.3 provides the statistical relationship between population exposure and the induction of fatal cancers that might appear over a period of many years following exposure. The impacts of total population and the population within 80 km (50 mi) are shown separately. Further, the fatal latent cancers have been subdivided into those attributable to exposures of the thyroid and all other organs.

Figure J.4 shows the probability distribution for costs of offsite mitigating actions for severe CRBRP accidents. This calculation is based on the RSS economic consequence model, described in detail in Section 12 of Appendix VI of WASH-1400 (NUREG-75/014). It shows that at the extreme end of the accident spectrum the costs of adverse health effects mitigation could be higher than a hundred million dollars.

(4) Liquid Pathways

Surface water hydrologic properties at CRBRP should be similar to those used for the Liquid Pathways Generic Study (LPGS) small river site, which was based on the Clinch-Tennessee-Ohio-Mississippi Rivers system, although the river uses and populations in the LPGS (NUREG-0440) were based upon national averages and have not been directly compared to the CRBRP. The groundwater characteristics at Clinch River do not indicate any unusually adverse transport characteristics.

Additionally, the CRBRP is a considerably smaller plant than the LPGS case (CRBRP is 1121 MWt vs. 3425 MWt assumed for the LPGS), and contrary to the LWR characteristics, CRBRP does not contain any large storage of water that could serve as a potential "prompt source" to the environmental liquid pathways. Therefore, only the radioactive material leached from the core debris by the local groundwater is likely to be transported to the Clinch River. This source was found in the LPGS to be considerably smaller than the "prompt source." Therefore, based on the preliminary appraisal of the liquid pathways, the staff concludes that the liquid pathways impacts of CRBRP would be probably smaller than those for the LWRs analyzed in the LPGS small river site case.

(5) Other Economic Risks

There are economic impacts and risks other than environmental risks that can be given a monetary value. These are accident impacts on the facility itself that result in added costs to the public, primarily taxpayers. These costs would be for decontamination and repair or replacement of the facility and for replacement power. Although it is possible that the facility would simply be decommissioned rather than restored following a serious (core-melt) accident, an assumption of restoration is considered conservative (high cost) in reflecting the cost impact of an accident. If the worth of the facility at the time of an accident is perceived to be less than the cost of restoration of the facility, then presumably the facility would not be restored and the cost impact would be less than the restoration cost, so that use of the restoration cost would represent a high side estimate. Because the worth of the CRBRP facility is primarily in the nature of research and development, the actual value cannot be quantified any more accurately than it would be perceived at the time.

Experience with such costs is currently being accumulated as a result of the Three Mile Island accident. Although CRBRP is considerably smaller in electrical output than the Three Mile Island plant, the physical size and complexity of the CRBRP is comparable and the cost of decontamination and restoration is estimated to be about the same as that for Three Mile Island. If a Class 9 accident occurs during the first full year of CRBRP operation (1990), the economic penalty associated with the initial year of the unit's operation is estimated at \$2470 million for decontamination and restoration, including replacement of the damaged core. This is based on a \$952 million value in 1980 dollars as reported to Congress by the Comptroller General (1981). The \$952 million in 1980 dollars has been escalated at 10% to 1990. Although property damage insurance would cover part of this, the insurance is not credited because the insurance payment times the risk probability would theoretically balance the insurance premium.

In addition, the staff estimates average additional production costs of \$27 million (1990 dollars) for replacement power during each year the CRBRP is being restored. This is based on the applicant's net projections of operating savings during the first 6 years of operation, discounted at 10% to 1990. Assuming the nuclear unit does not operate for 8 years due to shutdown, the total additional replacement power cost should be approximately \$220 million in 1990 dollars.

The probability during each year of the unit's service life of sustaining a total loss of the original facility as a result of a disabling accident is taken from Table J.2 as 1.0×10^{-4} . Multiplying the previously estimated costs of \$2690 million for an accident to the CRBRP during the initial year of its operation by the above 1.0×10^{-4} probability results in an economic risk of approximately \$270,000 (in 1990 dollars) applicable to the CRBRP during its first year of operation. This is also approximately the economic risk (in 1990 dollars) to the CRBRP during the second and each subsequent year of its operation. Although the CRBRP would depreciate in value such that the economic consequences of an accident become less as the unit becomes older, this is considered to be offset by a higher cost of decontamination of the unit in the later years.

(6) Uncertainties

The foregoing estimates of frequencies and risks associated with the CRBRP have included allowances for uncertainties. For example, unavailability estimates for shutdown and heat removal systems have been set high enough to include allowances for potential common cause failures. However, the risks from sabotage or from external natural events such as earthquakes, tornadoes, and floods beyond design bases for such events are difficult to quantify. This situation is generic to LWRs and advanced reactors such as the CRBRP. NRC is presently devoting significant effort to developing methods for quantifying risks from such events. Compliance with current NRC siting, structural, and seismic design criteria and with 10 CFR 73 for physical security provides assurance that reactor-related risks from external events and sabotage are adequately low. The CRBRP design will be required to meet all these criteria. Risks and the uncertainties in risks from the CRBRP related to sabotage and to external events are not expected to differ significantly from such risks and their associated uncertainties at LWRs.

A potential containment failure mode not quantified in Table J. 2 involves early containment failure and release caused by either a spray fire or missile generated from a very energetic CDA. The staff will review the potential for CDA energetics to ensure that necessary design enhancements of the primary coolant system are incorporated so that the probability of primary coolant system failure as a result of physically reasonable core rearrangement of sodium, cladding, or fuel will be very small. However, because it is possible to hypothesize nonmechanistic and speculative coherent and rapid core reconfigurations leading to high reactivity ramp rates, high energetics cannot be entirely precluded. Quantification of the frequency of this very improbable nonmechanistic event would involve such large uncertainties that the results would have no real meaning.

The estimated probabilities of severe accidents for the CRBRP do not depend in a significant way on the Reactor Safety Study (RSS), which was published in 1975. However, the RSS has been reviewed to gain the following perspective regarding representative system unreliabilities and general aspects of methodology and uncertainties:

In July 1977, the NRC organized an Independent Risk Assessment Review Group to (1) clarify the achievements and limitations of the Reactor Safety Study, (2) assess the peer comments thereon and the responses to the comments, (3) study the current state of such risk assessment methodology, and (4) recommend to the Commission how and whether such methodology can be used in the regulatory and licensing process. The results of this study were issued in September 1978. This report, commonly called the Lewis Report, contains several findings and recommendations concerning the RSS. Some of the more significant findings are summarized below:

- (1) A number of sources of both conservatism and non-conservatism in the probability calculations in the RSS were found which were very difficult to balance. The Review Group was unable to determine whether the overall probability of a core melt given in the RSS was high or low, but it did conclude that the error bands were understated.
- (2) The methodology, which was an important advance over earlier methodologies that had been applied to reactor risk, was sound.
- (3) It is very difficult to follow the detailed thread of calculations through the RSS. In particular, the Executive Summary is a poor description of the contents of the report, should not be used as such, and has lent itself to misuse in the discussion of reactor risk.

On January 19, 1979, the Commission issued a statement of policy concerning the RSS and the Review Group Report. The Commission accepted the findings of the Review Group. These findings have been considered in evaluating the potential risks from CRBR.

In the consequence calculations, uncertainties arise from a simplified analysis of the magnitude and timing of the fission product release, from possible variations in the core composition (see Appendix D), from uncertainties in calculated energy release, from radionuclide transport from the core to the receptor, from lack of precise dosimetry, and from statistical variations of health effects.

One area given considerable recent thought with respect to uncertainty is atmospheric dispersion. Although recent developments in the area of atmospheric dispersion modelling used in CRAC (the computer code developed in the RSS) indicate that an improved meteorological sampling scheme would reduce the uncertainties arising from this source (including the effect of washout by precipitation), large uncertainties would still remain in the calculations of radionuclide concentrations in the air and on the ground from which radiological exposures to an individual and the population are calculated. These uncertainties arise from lack of precise knowledge about the particle size distribution of the radionuclides released in particulate forms and about their chemical behavior. Therefore, the parameters of particulate deposition which exert considerable influence on the calculated results have uncertain values. The vertical rise of the radioactive plume is dependent on the heat and momentum associated with the release categories, and calculations of both factors have considerable uncertainty. The duration of release which determines the cross-wind spread of the plume is another example of considerable uncertainty. Warning time before evacuation also has considerable impact on the effectiveness of offsite emergency response; and this parameter is not precisely calculated because of its dependence on other parameters (e.g., time of release) which are not precisely known.

The state-of-the-art for quantitative evaluation of the uncertainties in the probabilistic risk analysis such as the type presented here is not well developed. Therefore, although the staff has made a reasonable analysis of the risks presented herein, there are large uncertainties associated with the results shown. It is the judgment of the staff that the uncertainty bounds could be well over a factor of 10 and may be as large as a factor of 100, but is not likely to exceed a factor of 100.

Accidents involving LMFBRs include those at EBR 1 and at Fermi 1; these accidents did not result in any significant release of radionuclides. The Fermi 1 accident led to design improvements to reduce the risk of such accidents at CRBR. The accident at EBR 1 occurred during an experiment; CRBR will not be used for such experiments. The accident at Three Mile Island occurred in March 1979 at a time when the accumulated experience record was about 400 reactor-years. It is of interest to note that this was within the range of frequencies estimated by the RSS for an accident of this severity. It should also be noted that the Three Mile Island accident has resulted in a very comprehensive evaluation of reactor accidents like that one, by a significant number of investigative groups both within NRC and outside of it. Actions to improve the safety of nuclear power plants have come out of these investigations, including those from the President's Commission on the Accident at Three Mile Island, and NRC staff investigations and task forces. A comprehensive "NRC Action Plan Developed as a Result of the TMI-2 Accident," NUREG-0660, Vol. I, May 1980, collects the various recommendations of these groups and describes them under the subject areas of: Operational Safety; Siting and Design; Emergency Preparedness and Radiation Effects; Practices and Procedures; and NRC Policy, Organization, and Management. The action plan presents a sequence of actions, some already taken, that result in a gradually increasing improvement in safety as individual actions are completed. The CRBRP will receive the benefit of these actions.

J.1.3 CONCLUSION

The foregoing sections have evaluated the environmental impacts of severe accidents, including potential radiation exposures to the population as a whole, the risk of near- and long-term adverse health effects that such exposures could entail, and the potential economic and societal consequences of accidental contamination of the environment. The assessment of environmental risk of accidents, assuming reasonable protective action, provides perspective on the overall risk from CRBRP accidents in comparison with those from LWRs. From this comparison, the staff concludes that CRBRP accident risks would not be significantly different from those of current LWRs. The analysis confirms the FES conclusion that the accident risks at CRBRP can be made acceptably low.

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APPENDIX K
PROPOSED RULE ON ALTERNATIVE SITES

NUCLEAR REGULATORY COMMISSION

10 CFR Part 51

Licensing and Regulatory Policy and Procedures for Environmental Protection; Alternative Site Reviews

AGENCY: U.S. Nuclear Regulatory Commission.

ACTION: Proposed rule.

SUMMARY: The Nuclear Regulatory Commission is proposing to amend its regulation in 10 CFR Part 51 to provide procedures and performance criteria for the review of alternative sites for nuclear power plants under the National Environmental Policy Act of 1969 (NEPA). The proposed rule provides for (a) information requirements for applying for an alternative site review by the Commission, (b) timing of Commission review, (c) region of interest to be considered in selecting sites, (d) criteria for the selection of sites, (e) criteria for comparing a proposed site with alternative sites, and (f) requirements for reopening an alternative site decision. It is also proposed that minor amendments be made to 10 CFR Part 2 and 10 CFR Part 50 to reflect the provisions of the proposed rule. Public comment is requested on the proposed rule, on whether safety matters including emergency response capability should be admitted as issues in alternative site reviews, and on the value/impact statement supporting the proposed rule.

DATES: Comments are due on or before June 9, 1980.

ADDRESSES: Interested persons are invited to submit written comments and suggestions to the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Docketing and Service Branch. Single copies of the value/

impact statement may be obtained on request from the Director, Division of Technical Information and Document Control. Copies of the value/impact statement may be examined in the Commission's Public Document Room at 1717 H Street NW., Washington, D.C.

FOR FURTHER INFORMATION CONTACT: Dr. Jerry R. Kline, Environmental Engineering Branch, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, telephone (301) 492-8251.

SUPPLEMENTARY INFORMATION:

I. Foreword

NEPA and NRC's environmental regulations in 10 CFR Part 51 have many provisions that shape the NRC's environmental reviews for nuclear power plants, but the basic underlying aspect is the consideration of alternatives. There are four distinct and different areas of NRC decisionmaking that involve alternatives, as described below:

1. One decision that must be made is whether additional baseload generating capacity need be provided. In other words, NRC considered the "no action" alternative, which includes consideration of conservation of energy.

2. A second decision that must be made by the NRC is whether nuclear fueled generation is an acceptable choice or whether other types of energy sources, e.g., coal, are superior.

3. A third NRC decision is whether the proposed site is acceptable. This particular decision involves the consideration of alternative sites; consideration of reasonable major mitigation measures that might be employed to make environmental impact acceptable at the candidate sites, such as the type of cooling system that should be employed at a particular site; and consideration of the costs of such major mitigation measures, as well as any major costs that might be required to make the site acceptable from a safety standpoint.

4. A fourth type of decision that is made involves whether other types of mitigation measures are warranted that normally would be of little importance to site selection, but may still be important from the standpoint of minimizing, to the extent reasonable, any residual adverse environmental impact that likely might be incurred during the construction or operation of the plant.

The proposed rulemaking focuses on the third type of NRC's environmental decisions—i.e., the question of alternative sites.

The NRC has considered the question of alternative sites in all of its NEPA reviews of applications to construct and operate nuclear power plants. As in most situations, however, the type and nature of the review has evolved over the years. Until recently, the NRC's review of the alternative site question has focused primarily on the qualities of the proposed site; i.e., a review that focuses on the "products" of an applicant's site selection process. The NRC typically did not initiate an extensive review of the applicant's site selection process and alternative site unless substantial inferior qualities were identified at the applicant's proposed site. However, the NRC has recently and dramatically expanded its review of the applicant's site selection process and procedures, as well as its review of the scope and depth of the detailed investigation of alternative sites.

The NRC believes that the experience gained in past and recent reviews of nuclear power plant sites should permit codification of the lessons learned into an intelligible, intelligent, and environmentally sensitive rule that governs the NRC review of alternative sites. While it is true that many of the issues that would be addressed by a rule on alternative site reviews could also be addressed more informally by issuance of regulatory guides and standard review plans and litigated in individual cases, some issues, particularly issues relating to notice and timing of public participation, can only be adequately addressed by rule. In addition, a comprehensive rule addressing review of alternative sites will promote public understanding of and participation in the NRC review of alternative sites. The proposed rule would:

1. Provide for more effective public participation by implementing procedural changes that: (a) require early notification of the public of an applicant's choice of a proposed site and its alternatives; (b) permit an early review of the alternative site question apart from other early site review issues; and (c) provide explicitly for consideration of candidate sites proposed by other parties that meet certain criteria and are proposed in a timely fashion.

2. Provide for greater predictability in the licensing process by (a) prescribing criteria for determining when a region of interest of sufficient size has been considered; (b) prescribing criteria for judging whether candidate sites are among the best that could reasonably be found; (c) prescribing the basic standards for comparing the proposed site to the alternative sites; and (d)

providing criteria for reopening the alternative site question after a previous NRC decision has been rendered on this subject.

The basic forces motivating the development of the proposed rulemaking are:

1. The necessity to protect the environment from unduly adverse environmental impacts, recognizing that the siting of a large, nuclear generating facility will result in some adverse impact regardless of where it is sited. Unduly adverse environmental impacts are an undesirable cost to society.

2. The realization that (a) reasonable bounds may be placed on the search for alternative sites without compromising environmental protection, and (b) the NRC's informational needs require the applicant to make a significant commitment of resources at the proposed site. As a general matter these costs are ultimately borne by the ratepayer and the taxpayer.

3. The fact that it is in the public interest to attempt to develop written, understandable NRC review and decisional criteria that provide for the necessary protection of important environmental qualities; i.e., criteria that are sensitive to the factors that would significantly and adversely impact the environment, yet still reasonably bound the consideration of alternatives to permit a rational and timely decision about the sufficiency of analysis.

Considering the above points, it should be noted that the proposed rule is environmentally based, but it does provide for other considerations (such as cost) to bound in a reasonable manner the search for candidate sites. The NRC fully realizes that an applicant does consider other factors in its site selection process. These factors are important to the applicant because they affect the economics and technical merits of the project and because many of these parameters affect reactor safety and thus must be reviewed and found acceptable by the NRC during the safety review process. The NRC sees no basic incompatibility between the environmentally-based rule proposed here and the fact that the applicant must realistically consider other, equally important, parameters in its formulation of a reasonable and effective site selection process. Also, it should be noted that the proposed rule (Section VI.2.b.(7)) includes threshold population criteria that are the same as the numerical values for population density contained in Regulatory Guide 4.7, "General Site Suitability Criteria for Nuclear Power Stations." This is reflective of past staff practice. However, these criteria may be changed

in accordance with an ongoing Commission review of siting policy which will be the subject of an advance notice of rulemaking in the immediate future.

To assist in the Commission's consideration of this question on population and related questions and as part of this proposed rulemaking on alternative sites, public comment is requested at this time on whether safety issues, including emergency response capability, should be admitted in the review and decisionmaking on alternative sites; and if so, how. At least two alternatives exist with regard to this question:

1. Establish, in a public rulemaking, exclusionary safety standards that must be met in order to have an acceptable site. Safety issues would not be considered in subsequent review of alternative sites, since such standards would be set sufficiently conservative that the residual radiological risk to the environment would be small and would be sufficiently similar to the residual risk at other reasonable sites in the region that an obviously superior alternative would likely not exist; i.e., these differences in residual radiological impacts would not weigh heavily in a NEPA-type cost-benefit balance. Such acceptance standards might include, for example, reasonable limits on population density, distances to towns and cities, distances to airports and other manmade hazards, and distances to capable faults.

2. Establish, in a public rulemaking, exclusionary safety standards that must be met, but also provide for inclusion of these safety issues in the consideration of alternative sites even when the sites meet these criteria. Such criteria may or may not be the same numerically as those addressed in 1 above. The rationale of this alternative rests on the view that even when a safety-related characteristic (e.g., population density) does not render a site unacceptable in any absolute sense, it may nevertheless involve sufficient residual risk to justify attempts to do better. The alternative sites evaluation process is suited to a determination of how well one can reasonably do in the particular area under consideration, since the process would illuminate specific alternatives. As an option, a second set of more conservative criteria might also be established which, if met, would not require that safety issues be included in the consideration of alternative sites.

With respect to population density, alternative 1 above would seek to obtain a similar result as alternative 2, i.e., acceptance thresholds, set in light of population density and distribution.

The NRC realizes that implementation will not, and should not, remove the controversy over the question of alternative sites. The question rightfully is a controversial one that elicits high public interest. The purpose of the rule is not to eliminate this controversy, but to focus it on factors of critical importance to the protection of the environment.

II. Background

NEPA requires the study and development of alternatives to any major Federal action that would significantly affect the quality of the human environment. The procedure for doing this must be an integral part of the planning and decisionmaking processes of Federal agencies. 10 CFR Part 51 establishes the NRC's licensing and regulatory policy and procedures under NEPA and requires that each applicant for a permit to construct a nuclear power plant discuss in an Environmental Report "Appropriate Alternatives" to the proposed facility. Among the primary alternatives to be considered, once the need for a nuclear facility has been established, are alternative sites for the facility.

The assessment of alternative sites for proposed nuclear power plants is a complex and difficult task, for the applicant, the NRC staff, and all parties in the process. Issues related to alternative siting have been a major source of controversy in a number of cases involving construction permits for nuclear power plants. The NRC has observed that there are some recurring issues at the heart of the controversy. The Commission believes that these recurring issues can and should be resolved on a generic basis.

An NRC study group seeking to identify ways to improve the effectiveness of NRC nuclear power plant licensing procedures recommended in June 1977 (see NUREG-0292, "Nuclear Power Plant Licensing: Opportunities for Improvement") that, among other measures, rulemaking should be considered for the generic resolution of certain issues presently litigated in individual licensing proceedings. An interim policy statement on generic rulemaking was published in the Federal Register on December 14, 1978, with a 90-day period for public comment ending on March 12, 1979. Additional technical detail on the ten issues identified by the staff for possible rulemaking was provided in NUREG-0499, "Preliminary Statement on General Policy for Rulemaking to Improve Nuclear Power Plant Licensing."

One of the ten issues proposed by the staff for consideration in generic rulemaking was alternative siting methodology and information requirements. Recognizing the need for further clarification of this issue, the staff issued Supplement No. 1 to NUREG-0499, a staff report entitled "General Considerations and Issues of Significance on the Evaluation of Alternative Sites for Nuclear Generating Stations Under NEPA." The major purpose of the report was to provide additional information to members of the public, industry, and other governmental agencies who intended to comment by March 12, 1979, on issues of alternative siting.

In addition, the NRC conducted a workshop to actively seek out comments on the alternative sites issue. This workshop provided invited representatives from industry, State and Federal government, public interest groups, and others the opportunity to scrutinize and comment on the NRC staff's most recent thinking on the issue of alternative sites.

Comments and feedback received from the workshop participants and observers, and those received from the public review of Supplement 1 to NUREG-0499, have been considered in the development of the proposed rule on alternative sites.

This proposed rule sets forth the resultant NRC policy regarding the evaluation of alternative sites for nuclear power plants under NEPA. The proposed rule is intended to (1) fulfill the NEPA objectives of ensuring that environmental factors have been fully considered in NRC decisionmaking; (2) reduce uncertainty and delay in the decisionmaking process; (3) reduce Federal paperwork in NEPA statements; and (4) limit alternative site review to relevant and material issues. The basic objective of this rule is to provide for a meaningful, rational, understandable, and stable NRC review and decisionmaking process that will both reasonably protect environmental values and yield a timely decision.

The intent of this proposed rule is to establish procedural and performance criteria for the identification and evaluation of alternative sites for nuclear power plants. Controversy with regard to the issue of alternative sites will not and should not be eliminated. This proposed rule will, however, focus the controversy on whether criteria important to environmental protection have indeed been met.

The NRC has considered the values and impacts of rulemaking and of alternative actions. These considerations have been put forth by

the Commission's staff in a value/impact statement.

III. The Role of NRC and Others in the Considerations of Alternative Sites

The NRC has the statutory responsibility to review applications for the construction and operation of nuclear power plants. It must assure the accuracy and relevance of environmental information, perform the environmental analyses, and make the decision to accept or reject a site. In carrying out its responsibilities, the NRC does not select sites or participate with the applicant in selecting a proposed site. However, the NRC is the lead Federal agency under NEPA for carrying out the NEPA mandate that alternative sites be considered in connection with nuclear power plant licensing.

The NRC may give appropriate deference to other Federal agency expertise in the assessment of certain impact, e.g., U.S. Environmental Protection Agency expertise in evaluating aquatic impacts. The Commission has also stated that "the fact that competent and responsible State authority has approved the environmental acceptability of a site or project after extensive and thorough environmentally sensitive hearings is properly entitled to 'substantial weight' in the conduct of our own NEPA analysis." Public Service Company of New Hampshire, et al. (Seabrook Station, Units 1 & 2), 5 NRC 503 at 527 (1977). Additionally, consideration is given to other information developed by State, regional, and local agencies (such as land or water use plans).

The proposed rulemaking represents no change in the above stated present practice.

IV. The Proposed Rule

A rule must address those elements of the alternative siting process that are generic in nature and likely to recur in all or many of the cases likely to be encountered. In formulating the proposed rule, the staff identified six major issues associated with alternative site consideration. These are (1) information requirements, (2) timing, (3) region of interest, (4) selection of candidate sites, (5) comparison of the proposed site with the alternative sites, and (6) reopening of the alternative sites decision.

The following sections provide a statement of each element of the proposed rule, describe its relation to present practice, and discuss the need for the rule and rationale for each element of the rule. The elements of the rule are organized to reflect the logic and chronology of a normal NRC review

of alternative sites in response to an actual submittal for such a review.

A. Information Requirements

A-1. Notice of Intent

1. *Statement of Rule.* An applicant is to provide the NRC staff with a notice of intent to tender an application for a construction permit (CP) for a nuclear power plant either at least three months before tendering of a CP application requesting an early review of the alternative sites issue (pursuant to § 2.101 and subpart F of 10 CFR Part 2) or 3 months prior to beginning the detailed studies on the proposed site, whichever comes first. The notice of intent will identify the location, cooling water sources, and physiographic unit of the proposed and alternative sites, as well as describe the anticipated generating capacity, the number of generating units, and the types of condenser cooling systems that would be used.

2. *Relationship to Present Practice.* Present NRC rules do not require submittal of such a notice, and present practice does not yield the information on cooling systems or alternative sites at the times specified.

3. *Need for Action.* Early public notification is needed to allow the public to become aware of the project, to identify their concerns and to express those concerns in advance of significant financial commitments by the applicant and at a time when due consideration of their concerns would not result in unacceptable schedule delays.

4. *Rationale and Discussion.* After receiving a notice of intent as required by the rule, NRC would publish the information received in the Federal Register and in newspapers local to the sites identified. This would assure that potential public participants have sufficient time prior to the NRC review to prepare meaningful information to be considered early in the licensing process. This provision is in direct response to a recommendation from several workshop participants.

For situations where, on the effective date of this rule, a future applicant has already begun or is about to begin detailed, long-term investigations on a site likely to be proposed subsequently to the NRC as a site for a nuclear power plant, such a future applicant must provide a notice of intent within three months following the effective date of this rule.

A.2. Reconnaissance Level Information

1. *Statement of Rule.* Reconnaissance level information, i.e., information or analyses that can be retrieved or

generated without the performance of new, comprehensive site-specific investigations, is normally adequate as a basis for identifying candidate sites and for selecting a proposed site.

Analysis of the slate of candidate sites may address other aspects of siting that are important to the applicant's decision, but must address the following subjects that are important to the NEPA reviews: hydrology, water quality and availability, aquatic and terrestrial biological resources, land use, transmission requirements, socioeconomic, population distribution and density, facility costs, institutional constraints, and public concerns where such have been provided to the applicant or NRC in writing.

2. Relationship to Present Practice.

Present practice is that the analysis of alternative sites is normally based upon readily available, reconnaissance level information such as provided by scientific literature, reports of government and private research agencies, consultation with experts, and brief field investigations. The scope of depth of the data and analysis required are matched to the importance of possible impacts and the degree of certainty regarding their magnitude. In some cases, detailed investigations related to specific issues may be required.

While detailed site-specific baseline studies on the proposed site are required to support the remainder of the NRC's environmental review, these data normally add little to NRC's determinations regarding alternative sites. These detailed studies principally serve as a basis for decision-making regarding mitigative measures to reduce (on a practicable basis) any residual adverse environmental impacts. However, they also serve a secondary purpose in that they confirm judgments on likely adverse environmental impacts that are made using reconnaissance level data. On occasion these studies may not confirm such judgments, but may lead to a finding that the proposed site is unacceptable.

The proposed rule on reconnaissance level information represents no change in the above stated practice.

3. Need for Action. Present practice is sufficiently well established through licensing experience to permit rulemaking on information requirements for alternative site analysis.

4. Rationale and Discussion. The rationale for the rule on reconnaissance level information proceeds from the premise that major adverse environmental impacts can normally be identified using this type of information. Therefore, the added costs of requiring

detailed site-specific investigations and analyses on all candidate sites normally would not be justified with respect to any marginal improvement in environmental protection. There was substantial discussion during the workshop on the applicability of reconnaissance level information to alternative site analyses. Many workshop participants emphasized that the term "reconnaissance level information" should not be interpreted to mean the reliance on limited data and subsequent superficial analyses. Such an interpretation is not intended, thus the proposed rule has been drafted to ensure that this misinterpretation will not occur.

B. Timing

1. Statement of Rule. Under the proposed rule an applicant may submit the proposed and alternative sites for NRC evaluation as part of a full construction permit review either early and separate from the review of plant design (an early site review) or in conjunction with the review of plant design. An early site review (ESR) of alternative sites may be in conjunction with or separate from consideration of other ESR issues. The applicant may later submit other siting issues for an early site review during the effective period of the early alternative sites partial decision.

2. Relationship to Present Practice. In the past, the NRC's review of alternative sites has generally occurred concurrently with the review of all other environmental issues and at the same time as the CP safety review of facility design. However, NRC regulations do provide for a single optional early site review, which may include any issues involving environmental impact or site safety that the applicant desires to address at a proposed site. While the applicant must describe the site selection process in an early site review, the review of specific alternative sites need not be addressed unless it is believed by the NRC that the consideration of other issues could prejudice the full consideration of alternative sites at a later time.

The proposed rule on timing represents a change in the above stated practice in that early review of the full question of alternative sites would be permitted in advance of the other early site review issues, and a subsequent early review would be allowed to consider the detailed baseline studies at the proposed site.

3. Need for Action. The option for early review of alternative sites is needed to permit a full consideration before the applicant commits substantial

resources to the proposed site. If a favorable decision is made on the alternative site question, the applicant could then commit the funds necessary to perform early site-specific studies of environmental and safety matters with a greater degree of confidence that the proposed site will not subsequently be rejected in favor of an alternative.

4. Rationale and Discussion. A two-stage early site review process is permitted to provide incentive for an early review of the alternative site question. In this way an early decision could be arrived at on alternative sites; after which the applicant could expend the necessary resources for detailed site-specific studies and apply at a later date for the remainder of a full early site review. Thus, less of the applicant's resources would be placed at risk prior to an NRC decision on alternative sites, and yet the applicant and the public would ultimately be able to achieve all of the ultimate benefits of an early site review.

All reviews and decisions would still be performed within the effective period for the early site review decision. All that would be added would be the opportunity to receive a regulatory decision on the question of alternative sites shortly after the applicant has decided upon the proposed site, but prior to the commitment of substantial funds at that proposed site.

C. Region of Interest

1. Statement of Rule. The initial geographic area for determining the region of interest for NRC regulatory review purposes may be either the State in which the proposed site is located or the service areas of the applicant. The actual region of interest must be larger in accordance with Section V.3 of the rule, or may be smaller in accordance with Section V.2 of the rule, depending on the environmental diversity, institutional factors, and cost considerations set forth in those sections.

For the purpose of determining the region of interest, environmental diversity refers to the types of water bodies available within the region (upper or lower reaches of large rivers, small rivers, lakes, bays, and oceans) and the associated physiographic units.

2. Relationship to Present Practice. Past practice has normally been to accept the applicant's proposed region of interest which commonly is the applicant's service areas. However, the region of interest has been smaller in some situations, and in other situations an expansion of the proposed region of interest has been required. This rule preserves that practice, but it adds

specific criteria for expansion or contraction of the initial geographic area in determining the region of interest.

3. *Need for Action.* The basic forces motivating the development of this rule are:

a. The necessity to protect the environment from unduly adverse environmental impacts by providing an adequate choice of candidate sites representing reasonable environmental alternatives, and

b. The realization that reasonable bounds may be placed on the search for alternative sites without compromising environmental protection.

4. *Rationale and Discussion.* The use of service areas coupled with performance criteria for expansion or contraction is judged to be sufficient to provide a substantial range of environmental alternatives from which to choose in making the final siting decision. Unlimited expansion of the areas to be searched likely would not yield significant additional new alternatives for limiting of environmental impacts that would already be present in a reasonably bounded area. As a practical matter, utilities may initiate their searches within their service areas. In many cases this will lead to the identification of the required diversity of resources. Where service areas are small, the requirement could cause an expansion that would extend the region of interest beyond the service area boundaries. However, in very large service areas, the required diversity might be found without exploring the entire service area.

The requirements may impose a need for large regions of interest in water limited areas, particularly in the western regions of the nation. The rule is intended to ensure in all cases that all reasonable alternatives have been considered. The analysis of remote alternatives need be carried only as far as necessary to demonstrate the reasons (which include costs) for not considering them further.

The rule is intended to apply to utilities having well defined service areas as well as those that do not. In situations where the State is asking the review of the alternative sites issue or where the service areas of the applicant are not defined, the State in which the proposed site is located would be the starting point for determining the region of interest.

When considering water sources that would provide adequate water availability, the staff intends that the characteristics of the terrestrial watershed (i.e., the physiographic characteristics) also be included and

considered. Under this concept, a river having adequate water for a nuclear power plant but that flows through a dedicated terrestrial area such as a national park or national forest might not qualify as an acceptable resource. It is permissible, however, to designate portions of a watershed for possible siting while excluding other portions of the same watershed.

Different portions of a watershed or coastal zone may be considered to be different physiographic units, if the environmental impacts of siting in these areas would be clearly different from one another. For example, the "head waters" region of a river watershed would be designated as a physiographic unit separate from the estuarine region of the same watershed, since the impacts on fisheries and other aspects of the environment would be clearly different in the two areas. The rule is not intended to compel the consideration of water bodies that are in similar physiographic settings, since that would not add significantly to the range of environmental choice.

In emphasizing the terrestrial components the staff intends that the search for sites should not be confined to land areas immediately adjacent to water bodies but should be expanded to include a reasonable corridor of search around the water body. Siting up to several miles from a suitable water body may be desirable to avoid land use conflicts that are often found adjacent to water bodies.

The workshop participants unanimously supported the concepts of (1) environmental diversity as a determinant in bounding the region of interest, and (2) water being the principal regional determinant of environmental diversity.

D. Selection of Candidate Sites

1. *Statement of Rule.* An applicant may submit a slate of candidate sites based on either (1) a demonstration (according to criteria for site selection procedures set forth in the rule) that the site selection methodology is a reasonable, environmentally sensitive site screening process that provides a diligent search for sites that are among the best that could reasonably be found, or (2) a demonstration that the slate of candidate sites meets the prescribed environmentally sensitive threshold criteria (set forth in the rule) and are therefore among the best that could reasonably be found. The rule states that a slate of candidate sites should contain at least four sites. The rule also provides criteria for acceptance of candidate sites proposed by any party to the proceeding.

2. Relationship to Present Practice.

Present practice is to make a determination that candidate sites identified by the applicant are "among the best that reasonably could have been found." Until recently, the NRC's review has focused primarily on the qualities of the proposed site (a product-oriented review). However, recently the NRC has expanded its review and the staff presently reviews the demonstration of this "among the best" standard by focusing on the adequacy of the applicant's site selection procedure (a process-oriented review). The rule preserves the advantages of both the process-oriented and product-oriented approaches. The rule adds criteria for implementing an adequate site selection process demonstration and evaluation, and provides the option for a product-oriented review by specifying threshold criteria for evaluating the slate of candidate sites. Most of the workshop participants believed that the applicants should be given the option to seek either a process-oriented or a product-oriented review of the slate of candidate sites.

3. *Need for Action.* The process-oriented approach codifies the elements that govern NRC reviews of the site selection process and provides guidance for the applicant's management of that site selection process. The product-oriented approach emphasizes the environmental merits of the candidate sites rather than the process that yielded these sites, and will likely be a more environmentally sensitive approach.

4. *Rationale and discussion.* The rationale for codifying the process-oriented approach is to provide guidance to all parties regarding the elements that govern NRC reviews of that process. The general rationale for the product-oriented approach is that candidate sites that pass all of the proposed threshold standards would be unlikely to have substantial, unidentified, adverse environmental impacts. Therefore, the resulting slate of candidate sites likely would be of comparable environmental quality and should be environmentally acceptable to the NRC. While there could be a situation where the proposed site could be marginal with respect to several of the thresholds and thus might be inferior on a cumulative impact basis, it would be unlikely that all the candidate sites would be similarly inferior. Thus the proposed site's inferiority would be clearly displayed in the subsequent detailed comparison with the other candidate sites.

The rule provides that the slate of candidates sites should contain at least four sites. The reason for this is to

ensure that even in regions of little diversity, there is some choice among the sites in the slate. For more diverse regions the criteria controlling how many sites would be necessary are oriented towards the diversity of environmental qualities presented, so as to give a meaningful environmental comparison of alternatives. The candidate sites would be required to be reasonably representative of all of the major diverse environmental qualities present in the region of interest, as follows:

- a. Major types of water sources.
- b. Major physiographic units.
- c. Consideration of sites of existing electric generating facilities as well as new sites.

As an example of acceptable diversity, if a new site on a lake in a woodland area was already identified as a candidate site, a woodland site on another lake within the region of interest would not be required, unless that site also hosts an existing electric generating facility.

One of the positions adopted by the public workshop on alternative sites is that public participation in the siting process would be enhanced if parties other than the applicant were permitted to propose additional candidate sites for consideration, but that the criteria proposed for acceptance of such sites should be no more stringent than those which the applicant's sites must meet. Criteria are proposed for the acceptance of such a site that are essentially the same criteria that the applicant's sites must meet in establishing the original slate of candidates.

In addition, the proposed rule imposes time limits for proposing additional candidate sites. The time limits are a key element in achieving a timely evaluation of the alternative sites issue and, except upon a substantial showing of good cause, will not be extended.

E. Comparison of the Proposed Site With Alternative Sites

1. *Statement of Rule.* A proposed site that comes from a slate of candidate sites that are among the best that could reasonably be found will not be rejected by the NRC on the basis of the alternative site review unless a comparison with the alternative sites results in a determination that an obviously superior alternative exists. There will be a two-part, sequential test for obvious superiority. The first stage of the test will be to determine whether there is an environmentally preferred site. The second stage of the test will consider economics, technology, and institutional factors to determine whether any environmentally preferred

site is obviously superior to the proposed site.

2. *Relationship to Present Practice.* Present staff practice does consider the range of factors that would be addressed by the proposed rule.

3. *Need for Action.* This proposed element of the rule will provide a more stable structure for the procedural aspects of how environmental factors should receive consideration and how these factors should be balanced with non-environmental factors to determine obvious superiority.

4. *Rationale and Discussion.* The criteria for testing the proposed site against the alternative sites comes from past practice, as reflected in individual nuclear power plant licensing reviews.

F. Reopening of the Alternative Site Decision

1. *Statement of Rule.* a. A reopening and reconsideration of the alternative site decision after a final limited work authorization or construction permit decision will be permitted only upon a reasonable showing that there exists significant new information that could substantially affect the earlier decision. Any decision to reconsider the alternative sites decision or not in these instances will consider the reasonable costs of delay and of moving to another site compared with the adverse environmental impacts that might be avoided by moving to another site.

b. For cases where the portion of the construction permit application containing facility design is filed three years or more after the effective date of this rule and where an application for an early review of alternative sites was tendered at least two and a half years prior to filing the portion of the CP application containing detailed facility design information, any reconsideration of the alternative site decision will be permitted only upon a reasonable showing that there exists significant new information that could substantially affect the earlier decision, even when allowance is made for reasonable costs of delay and of moving to another site. If such an application was not made at least two and a half years prior to filing such portion of the CP application, costs of delay and of moving to another site will not be considered in any decision to reconsider the alternative site decision or not, or in any resulting decision that there is or is not an obviously superior site.

c. If two sites are reasonably within a region of interest for a nuclear power plant site and both sites have received an affirmative NRC partial decision in an early review of alternative sites, an applicant may choose either site for an

application to construct a specific nuclear power plant without reviewing the alternative site question, except on the basis of new information, as provided above.

2. *Relationship to Present Practice.* The proposed rule is generally consistent with present criteria regarding treatment of new information under the early-site-review rule, and would result in consistent criteria for the treatment of new information regarding alternative sites at the construction permit and operating license stages.

The treatment of forward costs associated with moving to another site (including costs of delay) prescribed in this element of the proposed rule would generally codify a practice that has evolved, except that it would preclude the consideration of costs of moving to another site if the applicant did not seek an early resolution of the alternative site question.

3. *Need for Action.* This proposed element of the rule will provide for consistent treatment of new information regarding alternative sites throughout the licensing process.

4. *Rationale and Discussion.* The rationale for this element of the proposed rule is that after a decision has been reached regarding the alternative site question, during either an early site review or a CP review, the applicant (or licensee) will logically begin committing greater resources to that site. While such commitments are clearly at the applicant's risk, it is logical to allow the inclusion of such costs in any subsequent cost-benefit analyses, since such investments would have been made by the applicant in good faith.

Therefore, while it is possible that a reversal of the previous decision could be made based on new information (which is a risk the applicant or licensee must run), any reconsideration of the question of alternative sites and the cost-benefit analysis supporting any reversed decision should normally permit the full accounting of all reasonable forward costs to develop the new site (including costs of delay) compared to the reasonable forward costs of completing the project at the previously approved site.

At some point after issuance of the CP, the alternative of siting the nuclear power plant elsewhere likely will no longer be a reasonable alternative for the purposes of NEPA. That is, there is a point where comparative forward costs and the temporal proximity to the provision of needed (or desirably substitutable) power so favor the partially constructed site that, there likely is no real possibility that the nonsafety-related considerations at an

alternative site would be obviously superior to the proposed site. At that point, the reconsideration of alternative sites likely would not be required, unless the proposed site has been judged unsuitable for some safety or environmental reason.

Forward costs also could become substantial after an early site review decision, particularly as the time for a CP decision approaches. This means that a reevaluation of alternative sites after an early site review decision likely would not be justified on the basis of a full cost-benefit analysis unless there is, for example, a determination that the actual use of the site (rating and number of units) would be greater than had been evaluated earlier, or that firm and major changes in land or water use or changes in legal requirements involving the protection of species or resources have occurred since the previous evaluation. It is unlikely that changes in the prediction of environmental impacts would be so great as to warrant a re-review of the alternative sites decision on that basis alone.

The rationale for the third criterion of this portion of the proposed rule is that if two sites in the same general region of interest had been evaluated in separate reviews and neither had been found to have an obviously superior alternative, then it is likely that neither would be obviously superior to the other.

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, and section 553 of title 5 of the United States Code, notice is hereby given that adoption of the following amendments to 10 CFR Part 2, 10 CFR Part 50, and 10 CFR Part 51 is contemplated. All interested persons who desire to submit written comments should send them to the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Attention: Docketing and Service Branch, Washington, D.C. 20555 by June 9, 1980. Copies of comments received will be available for public inspection at the Commission's Public Document Room at 1717 H Street, NW., Washington, D.C.

§ 2.603 [Amended]

1. It is proposed that § 2.603(a) be amended by adding at the end thereof the following:

(a) * * * Where an applicant has failed to file the notice of intent required by Appendix A of 10 CFR Part 51, the application shall be docketed in accordance with the provisions of that appendix.

§ 2.605 [Amended]

2. It is proposed that § 2.605(a) be amended by adding at the end thereof the following:

(a) * * * Where an application has been filed pursuant to Appendix A of 10 CFR Part 51 for an early alternative site evaluation separate from other early site review issues, the alternative site evaluation shall not be considered a review for purposes of this one review limitation.

Appendix Q [Amended]

3. It is proposed that the numbered paragraph 1. of Appendix Q of 10 CFR Part 50 be amended by inserting between the first and second sentence thereof the following:

"As a part of an early site review, either in conjunction with or separate from the consideration of other early site review issues, a person may submit a request for a review of the alternative site issue and for issuance of a Staff Site Report concluding that there is no obviously superior alternative to the proposed site. If the person requests an early alternative site review separate from the consideration of other early site review issues, the person may later submit other siting issues for an early site review during the effective period of the Staff Site Report on the alternative site issue, provided that any later early site review of other issues shall remain in effect only so long as the initial Staff Site Report on alternative sites remains effective."

4. It is proposed that the numbered paragraph 3. of Appendix Q of 10 CFR Part 50 be amended by adding at the end thereof the following:

"Where a person has failed to file the notice of intent required by Appendix A of 10 CFR Part 51, the request for review shall be acted upon in accordance with the provisions of that appendix."

5. It is proposed that the numbered paragraph 5 of Appendix Q of 10 CFR Part 50 be amended by deleting the last sentence thereof and substituting the following:

"The conclusions of the Staff Site Report will be reexamined by the staff where five years or more have elapsed between the issuance of the first Staff Site Report and its incorporation by reference in a construction permit application."

6. It is proposed that the first sentence of the numbered paragraph 7. of Appendix Q of 10 CFR Part 50 be amended by adding at the end thereof the following:

"However, if a person, pursuant to Appendix A of 10 CFR Part 51, has submitted a request for an early alternative site review separate from other early site review issues, the alternative site review shall not be considered a review for purposes of this one review limitation."

7. It is proposed that a new Appendix A be added to 10 CFR Part 51 to read as follows:

Appendix A.—Evaluation of Alternative Sites for Nuclear Power Plants

I. Introduction and Scope

This appendix sets forth procedures and performance criteria for the review of alternative sites for nuclear power plants under NEPA. Specifically, this appendix provides for (a) information requirements for applying for an alternative site review by the Commission, (b) timing of Commission review, (c) region of interest to be considered in selecting sites, (d) criteria for the selection of sites, (e) criteria for comparing a proposed site with alternative sites, and (f) requirements for reopening an alternative site decision.

The basic objectives of this appendix are:

1. To provide for more effective public participation by implementing procedural changes that (a) require early notification of the public as to an applicant's choice of a proposed site and its alternatives, (b) permit an early review of the alternative site question apart from other early site review issues, and (c) provide explicitly for consideration of candidate sites proposed by other parties that meet certain criteria and are proposed in a timely fashion; and
2. To provide for greater predictability in the licensing process by codification of present practice that (a) prescribes criteria for determining when a region of interest of sufficient size has been considered, (b) prescribes criteria for judging whether candidate sites are among the best that could reasonably be found, (c) prescribes the basic standards for comparing the proposed site to the alternatives sites, and (d) provides criteria for reopening the alternative site question after a previous NRC decision has been rendered on this subject.

The nuclear power plants referred to in this appendix are those facilities which are subject to § 51.5(a) of this chapter and are of the type specified in § 50.21(b)(2) or (3) or § 50.22 or are testing facilities. The submittal for review and evaluation of alternative sites shall be made in the same manner and in the same number of copies as provided in § 50.30(a), (c)(1), and (c)(3) for license applications.

II. Definitions

As used in this appendix,

1. "Region of interest" means the geographic areas considered in searching for candidate sites.
2. "Candidate sites" means those sites that are within the region of interest and are considered in the comparative evaluation of sites for a nuclear power plant and are judged to be among the best that can reasonably be found for the siting of a nuclear power plant.
3. "Proposed site" means the candidate site submitted to the NRC by the applicant, or a person requesting an early review pursuant to Appendix Q of 10 CFR Part 50, as the proposed location for a nuclear power plant.
4. "Alternative sites" means those candidate sites which are specifically compared to the proposed site to determine

whether there is an obviously superior alternative site.

5. "Slate of candidate sites" means the group of candidate sites comprised of the proposed site and all alternative sites.

6. "Environmentally preferred alternative site" means an alternative site for which the environmental impacts are sufficiently less adverse than for the proposed site that environmental preference for the alternative site can be established.

7. "Site" means the geographic area needed for the construction and operation of a nuclear power plant, including the associated transmission corridors to the first intertie.

8. "Reconnaissance level information" means any information or analyses that can be retrieved or generated without the performance of new, comprehensive site-specific investigations. Reconnaissance level information includes relevant scientific literature, reports of government or private research agencies, consultation with experts, short-term field investigations, and analyses performed using such information. The amount of reconnaissance level information and the extent of analyses conducted depend on (1) the importance and magnitude of the potential impact under evaluation and (2) whether the decision is one of identifying a region of interest, identifying candidate sites, or selecting a proposed site.

9. "Partial decision on alternative sites" means a partial decision pursuant to § 2.101 and Subpart F of 10 CFR part 2 that includes a finding that there is or is not an obviously superior alternative to the proposed site.

10. "Applicant" means a person who intends to apply, or who has applied, for a permit to construct a nuclear power plant.

11. "Notice of intent" means a notice that an application will be tendered for a construction permit for a nuclear power plant.

12. "NRC" means the Nuclear Regulatory Commission, the agency established by Title II of the Energy Reorganization Act of 1974, as amended.

13. "NRC staff" means any NRC officer or employee or his/her authorized representative, except a Commissioner, a member of a Commissioner's immediate staff, an Atomic Safety and Licensing Board, an Atomic Safety and Licensing Appeal Board, a presiding officer, or an administrative law judge.

III. Information Requirements

1.a. An applicant shall provide the NRC staff with a notice of intent to tender an application for a construction permit (CP) for a nuclear power plant either at least 3 months before tendering of a CP application requesting an early review (pursuant to § 2.101 and Subpart F of 10 CFR Part 2) of the alternative sites issue or at least 3 months before beginning detailed studies on environmental impact and site safety at the proposed site, whichever occurs earlier. The notice of intent shall identify the location, cooling water sources, and physiographic unit of the proposed and alternative sites, and shall describe the anticipated generating capacity and number and type of generating units for which a CP application will be

tendered, and types of condenser cooling systems that would be used.¹

Upon receipt of the notice of intent, the NRC will publish the information received in the Federal Register and in the newspapers local to the sites identified.

If an applicant fails to provide a notice of intent within the time specified, the NRC will not docket the tendered application for 3 months where no detailed studies of the proposed site have been performed or for 12 months where such studies have been performed. As soon as practicable after tendering, the NRC will publish the above specified information in the Federal Register and in the newspapers local to the sites identified.

b. A person requesting an early review of the alternative sites issue pursuant to Appendix Q of 10 CFR Part 50 shall provide the NRC staff with a notice of intent to submit such request at least 3 months before submitting the request for review or at least 3 months before beginning detailed studies of the proposed site, whichever occurs earlier. The notice of intent shall identify the location, cooling water sources, and physiographic unit of the proposed and alternative sites, and shall describe the generating capacity, number and type of generating units, and types of condenser cooling systems anticipated or assumed to be used.

Upon receipt of the notice of intent, the NRC will publish the information received in the Federal Register and in the newspapers local to the sites identified.

If the person requesting the review pursuant to Appendix Q to 10 CFR Part 50 fails to provide a notice of intent within the time specified, the NRC will not initiate the review for 3 months where no detailed studies of the proposed site have been performed or for 12 months where such studies have been performed. As soon as practicable after receiving the request for review, the NRC will publish the above specified information in the Federal Register and in newspapers local to the sites identified.

2. Reconnaissance level information shall normally be adequate to identify candidate sites and to select a proposed site in an alternative site analysis. In the identification of candidate sites or selection of the proposed site, the amount of data required and the extent of analyses conducted shall be appropriate to support a reasoned decision.

In some cases, reconnaissance level information may not be sufficient to support the analyses necessary to reach a reasoned decision. In these situations, new comprehensive site-specific investigations must be considered. For example, if substantial questions exist regarding the likely acceptability of a site from a geologic standpoint, substantial geotechnical investigations might be required. Also, if

¹For situations where, on the effective date of this rule, a future applicant has already begun or is about to begin detailed, long-term investigations on a site likely to be proposed subsequently to the NRC as a site for a nuclear power plant, such a future applicant must provide a notice of intent within three months following the effective date of this rule.

substantial questions exist regarding whether a large adverse impact will occur to an important aquatic species, long-term baseline studies will be considered. The NRC staff will advise the applicant of any additional information requirements as early as practicable.

3. Where a party to a proceeding proposes for consideration (according to Section VI.4.a of this appendix) a candidate site not included in the applicant's slate of candidate sites, it is the responsibility of that party to provide adequate information to support a decision to accept the site or not. If the site is accepted as a candidate site, it is the responsibility of the applicant in the proceeding to provide the information necessary to make the final comparison of that site with the proposed site.

4. Alternative site analyses of both the identification of the slate of candidate sites and the selection of the proposed site shall, at a minimum, address the following subjects:

- a. hydrology, water quality, and water availability
- b. aquatic biological resources, including endangered species
- c. terrestrial resources and land uses, including endangered species
- d. transmission corridors (approximate length and general location) and resources affected
- e. socioeconomic, including aesthetics, and archeological and historic preservation
- f. population distribution and density²
- g. facility costs
- h. institutional constraints, as they affect site availability
- i. public concerns in the above subject areas, where such have been provided to the applicant or NRC in writing.

IV. Timing of NRC Review

1. An applicant may submit the proposed and alternative sites for NRC evaluation as part of a full CP review either prior to and separate from the review of plant design (an early site review) or in conjunction with the review of plant design.

2. As part of an early site review, an applicant that tenders an application for an alternative site review and requests a finding that there is not obviously superior alternative to the proposed site may do so either in conjunction with or separate from the consideration of other early site review issues. If the applicant applies for an early alternative site evaluation separate from the consideration of other early site review issues, the applicant may later submit other siting issues for an early site review during the effective period of the early alternative site partial decision, provided that any later early site review of other issues shall remain in effect only so long as the initial early site review of alternative sites remains effective.

V. Region of Interest

1. The initial geographic area for determining the region of interest for NRC regulatory review purposes shall be (a) the State in which the proposed site is located or (b) the service areas of the applicant. The

²This requirement will be modified as appropriate to conform to revisions to 10 CFR Part 100.

actual region of interest must be larger than the initial geographic area according to 3. below, or may be smaller than the initial geographic area according to 2. below.

2. The region of interest may be smaller than the initial geographic area, if (a) environmental diversity is not substantially reduced and candidate sites within the region of interest meet threshold criteria described in Section VI.2.b. of this appendix, or (b) costs of generating electricity would be exorbitant for sites located in those areas not included, or (c) siting in those areas not included would be in violation of State laws governing nonradiological health and safety aspects of utility siting, or (d) the costs would be exorbitant of developing information to demonstrate whether sites within those areas not included would likely be acceptable from the standpoint of safety.

3. The region of interest must be greater than the initial geographic area if environmental diversity would likely be substantially increased and if (a) candidate sites within the initial geographic area meet the threshold criteria in Section VI.2.b. of this appendix, and the development of sites in the added geographic areas would likely not substantially increase costs, or (b) candidate sites within the initial geographic areas do not meet threshold criteria in Section VI.2.b., and the development of sites in the added geographic areas would not require exorbitant costs.

4. For the purpose of determining the region of interest, environmental diversity refers to the types of water bodies available within the region (upper or lower reaches of large rivers, small rivers, lakes, bays, and oceans) and the associated physiographic units. A substantial increase or decrease in diversity would occur whether the region of interest includes or excludes such a water body. In areas of critical water supply, ground water and waste water are also appropriate water sources for diversity considerations.

VI. Selection of Candidate Sites

1. The candidate sites used in the subsequent site-specific comparison of alternatives must be one of the following:

a. Be identified through the use of a site selection methodology that (1) includes an environmentally sensitive site screening process (i.e., considers the same environmental parameters that are addressed by the criteria in VI.2.b., although not necessarily in the same way) resulting in a slate of candidate sites that are among the best that could reasonably be found and (2) meets the criteria presented in VI.3. below; or

b. Meet the criteria presented in VI.2. below, in which case there shall be no further review of the site selection process.

2. a. A sufficient number of candidate sites, which should include at least four sites, shall be selected from the region of interest to provide reasonable representation of the diversity of land and water resources within the region of interest. One or more of these sites should be associated with each type of water source and physiographic unit reasonably available within the defined region of interest, and one alternative site must have the same water source as the proposed site.

b. Except as noted in 2.c.(1), a site must meet the following criteria to be accepted as a candidate site without further review of the site selection process. (Technically appropriate and economically reasonable cooling system mitigative measures may be assumed for each candidate site.)

(1) Consumptive use of water would not cause significant adverse effects on other water users.

(2) There would not likely be any further endangerment of a State or Federally listed threatened or endangered plant or animal species.

(3) There would not likely be any significant impacts to spawning grounds or nursery areas of significance in the maintenance of populations of important aquatic species.

(4) Discharges of effluents into waterways would likely be in accordance with State or Federal regulations (e.g., avoidance of discharges to waters of the highest State quality designation) and would not likely adversely affect efforts of State or Federal agencies to implement water quality objectives (e.g., additional discharges to waters of currently unacceptable quality as determined by a State).

(5) There would be no preemption or likely adverse impacts on land uses specially designated for environmental or recreational purposes such as parks, wildlife preserves, State and National forests, wilderness areas, flood plains, Wild and Scenic rivers, or areas on the National Register of Historic Places.

(6) There would not likely be any significant impact on terrestrial and aquatic ecosystems, including wetlands, which are unique to the resource area.

(7) The population density, including weighted transient population, projected at the time of initial operation of a nuclear power plant, would not exceed 500 persons per square mile averaged over any radial distance out to 30 miles from the site (cumulative population at a distance divided by the area at that distance), and the projected population density over the lifetime of the nuclear power plant would not exceed 1,000 persons per square mile (similarly weighted and measured).^a

(8) The site is not in an area where additional safety considerations (geology; seismology; hydrology; meteorology; and industrial, military, and transportation facilities) or environmental considerations for one site compared to other reasonable sites within the region of interest would result in the reasonable likelihood of having to expend substantial additional sums of money (cumulative expenditures in excess of about 5% of total project capital costs) to make the project licensable from a safety standpoint or to mitigate unduly adverse environmental impacts.

c. (1) If a site does not meet one or more of the threshold criteria provided in VI.2.b., the site may be acceptable as a candidate if it can be reasonably shown that further examination of that particular type of water source and physiographic unit would not

^a This requirement will be modified as appropriate to conform to revisions to 10 CFR Part 100.

likely identify a site that would meet those same threshold criteria.

(2) If any candidate site does not meet one or more of the threshold criteria provided in VI.2.b. to such an extent that serious adverse environmental impacts would result from its use, that site should be rejected as a candidate site.

3. If the approach of VI.1.a. above is relied upon, demonstration must be made that the site selection process incorporated the following criteria:

a. The overall objectives of the siting study and all initial constraints and limitations (including the geographic area, i.e., region of interest, which is the subject of the study) shall be explicitly stated giving the basis and rationale for all choices.

b. The proposed ways of meeting the stated objectives shall be described, including the general approach to the site selection process.

c. The study shall explicitly state factors (e.g., aquatic biology) under consideration, parameters (e.g., spawning grounds and nursery areas) by which these factors were measured, and criteria (e.g., no significant impact) that define levels of achievement.

d. The site selection study shall be interdisciplinary and shall include natural, social, and environmental sciences. The range of the responsibilities of the study team shall be clearly defined and the methods employed in resolving differences within the group or of arriving at the consensus shall be explicitly stated.

e. The process that led to the identification of candidate sites including all specific methodologies shall be explicitly stated in detail.

(1) Where preemptive screening is used, all limiting or exclusionary criteria employed shall be explicitly stated, the bases for each criterion given, and the ways in which they are applied explained.

(2) Where comparative analysis is used, all methodologies used involving importance factors, preference functions, utility functions, weighting factors, ranking scales, scoring schemes, and rating systems shall be explicitly described; the basis for the selection of each methodology given; and the ways in which each is applied explained.

f. The study shall contain detailed description of administrative means used to support the site selection study, including any quality assurance program commensurate with the objectives of the study and a data management system for handling technical files, maps, and other information.

g. Definitions of terms used in the study shall be included.

4. Any intervening party and the NRC staff may propose one or more additional sites for consideration as candidate sites provided that the following conditions are met:

a. The additional sites are proposed for review within 30 days after the first special prehearing conference (i.e., the conference held pursuant to § 2.751a of 10 CFR Part 2.).

b. The proposal contains a reasonable showing that the additional sites are comparable to the applicant's slate of candidate sites in their ability to meet the criteria specified in VI.2.b. and VI.2.c. and would add to the diversity which is exhibited

by the applicant's slate of candidate sites; or where the applicant's candidate sites do not meet all the criteria specified in VI.2.b. and VI.2.c., the proposal contains a reasonable showing that the additional sites will meet these criteria.

c. Where a party identifies more than one additional site, each additional site must meet one of the tests specified in VI.4.b. above.

d. The additional sites have no physical features that would likely create substantial increases in the cost of constructing and operating nuclear power plants at the additional sites compared with the applicant's proposed site, unless there is a reasonable showing that the additional sites meet a criterion specified in VI.2.b. that is not met by the applicant's proposed site.

e. Multiple parties to NRC proceedings should consult with one another prior to proposing additional sites for consideration as candidate sites in order to reasonably limit the total number submitted.

5. A presiding Atomic Safety and Licensing Board (ASLB) may on its own initiative proposed one or more additional sites for consideration as candidate sites up to 30 days after the issuance of the Draft Environmental Statement (DES). On or after the issuance of the DES, additional sites may be introduced by the ASLB, only after a balancing of the cost of delaying the proceeding against the likelihood that utilization of the additional site would avoid significant environmental harm.

6. The 30-day time limits in VI.4.a. and VI.5. above shall not be extended except upon a substantial showing of good cause.

VII. Comparison of Proposed Site With Alternative Sites

1. After it is determined by either of the above approaches that the proposed site comes from a slate of candidate sites that are among the best that could reasonably be found, the NRC will not reject the proposed site solely based on its review of the alternative sites unless a comparison with the remaining candidate sites results in a determination that an obviously superior alternative exists. The NRC will determine obvious superiority among the candidate sites by a sequential two-part analytical test. The first part gives primary consideration to hydrology, water quality, aquatic biological resources, terrestrial resources, water and land use, socioeconomic, and population⁴ to determine whether any alternative sites are environmentally preferred to the proposed site. The second part overlays consideration of project economics, technology, and institutional factors to determine whether, if such an environmentally preferred site exists, such a site is, in fact, an obviously superior site.⁵ The following factors are considered in this second part of the test:

⁴This requirement will be modified as appropriate to conform to revisions to 10 CFR Part 100.

⁵In applying both parts of the test, the NRC will give consideration to the inherent uncertainties of cost-benefit analysis techniques and, where applicable, to the disparity in the data base between the proposed and alternative sites.

a. The environmental and safety⁶ considerations in terms of technology and costs of construction and operation of nuclear power plants at the sites.

b. The forward costs⁷ at the proposed site compared to the alternative sites.

c. Other considerations, such as possible institutional barriers. The applicant's proposed site will be rejected solely based on NRC review of alternative sites only when the NRC determines that, considering both parts of the test, there is an environmentally preferable alternative which also is obviously superior, i.e., the NRC is confident that the applicant's proposed site should be rejected.

2.a. If an obviously superior alternative site is identified and the proposed site is rejected by the NRC, and if the applicant submits a new application naming the identified obviously superior site as the newly proposed site, the NRC will not require review of the alternative site question for the newly proposed site, provided that the previous slate of candidate sites had been determined to be acceptable by the criteria established in this rule.

b. If more than one obviously superior alternative site is identified and the proposed site is rejected by the NRC, the applicant may request that a further finding be made in that proceeding to determine whether one of those sites is obviously superior to the others. If that finding is made and one of those sites is obviously superior to the others and the applicant submits the obviously superior site as the new proposed site, the NRC will not require review of the alternative sites question for the newly proposed site, provided that the previous slate of candidate sites had been determined to be acceptable by the criteria established in this rule. If that finding is made and none of those sites is obviously superior to the others, the applicant may propose any of the obviously superior alternative sites for review as permitted according to 2.a. above.

c. If one or more obviously superior sites are identified and the proposed site is rejected by the NRC, the applicant may submit a new proposed site that is

⁶There are some site safety issues for which a cost-effective means for successful mitigation is not state-of-the-art engineering. For the purposes of alternative site analysis, these site safety issues are considered in terms of site acceptability, i.e., where successful mitigation is considered outside the state of the art, the site would be considered unacceptable. However, where the mitigation of the safety issues are considered to be within the state of the art, the site would be considered acceptable but still must undergo the comparative test, which includes the impact of the mitigation on overall project cost, to determine whether there is an obviously superior alternative. Even though the proposed site successfully passes the early evaluation of alternative sites, it could still be found unacceptable in the later detailed safety review of that site.

⁷For cases where the portion of the construction permit application containing facility design is filed 3 years or more after the effective date of this rule, and an early site review application for the review of alternative sites had not been filed at least 2½ years earlier, the costs of moving to another site, including costs of delay, will be given no weight in any consideration of alternative sites or in any decision whether to reopen a previous decision on this subject.

comparable to the obviously superior sites in its ability to meet the criteria specified in Section VI.2.b. Where a new site is proposed, appropriate public notice of intent is provided, and a showing of comparability in meeting the criteria is made, the NRC will only require that the sequential two-part analytical test for obvious superiority be performed on the new proposed site and on the sites found obviously superior in the earlier proceeding.

VIII. Reopening of the Alternative Site Decision

1. A reopening and reconsideration of the alternative site decision after a final limited work authorization or construction permit decision will be permitted only upon a reasonable showing that there exists significant new information that could substantially affect the earlier decision. Any decision to reconsider the alternative site decision or not in these instances will take into account preliminary estimates of the reasonable costs of delay and of moving to another site compared with the adverse environmental impacts that might be avoided by moving to another site.

2. For cases where the portion of the construction permit containing facility design is filed three years or more after the effective date of this rule and where an applicant submits the proposed and alternative sites for NRC evaluation as part of a full construction permit review at least 2½ years prior to filing the portion of the construction permit application containing detailed plant design, any reconsideration of the alternative site decision will be permitted only upon a reasonable showing that there exists significant new information that could substantially affect the earlier decision, as described in VIII.1. above. If the proposed and alternative sites were not submitted for NRC evaluation as part of a full construction permit review at least 2½ years prior to filing the portion of the construction permit application containing the plant design, costs of delay and of moving to another site will not be considered in any decision to reconsider the alternative site decision or not or in any resulting decision that there is or is not an obviously superior site.

3. If two sites are reasonably within a region of interest for a nuclear power plant site and both sites have received an affirmative NRC partial decision on an early review of alternative sites, an applicant may choose either site for an application to construct a specific nuclear power plant without reviewing the alternative site question, except on the basis of new information as provided in VIII.2. above.

(Sec. 161 h., i., o., Pub. L. 83-703, 68 Stat. 948 (42 U.S.C. 2201 (h), (i), and (o)); Sec. 102, Pub. L. 91-190, 83 Stat. 853 (42 U.S.C. 4332); Sec. 201, as amended, Pub. L. 93-438, 88 Stat. 1242; Pub. L. 94-79, 89 Stat. 413 (42 U.S.C. 5841))

Dated at Washington, D.C., this 4th day of April 1980.

For the Nuclear Regulatory Commission.
Samuel J. Chalk,
Secretary of the Commission.

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APPENDIX L
ALTERNATIVE SITES

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APPENDIX L

ALTERNATIVE SITES

INTRODUCTION

This appendix compares the proposed CRBRP site with seven candidate alternative sites in the context of the Commission's proposed rule on alternative sites (see Appendix K and Section 9.2.4 of this document). Four of the alternative sites are controlled by the Tennessee Valley Authority (TVA) and are within its power service area: Hartsville, Murphy Hill, Phipps Bend, and Yellow Creek (see Figure A9.1). The other three are under the jurisdiction of the Department of Energy (DOE) and are located elsewhere in the country: Hanford (WA), Idaho National Engineering Laboratory (INEL)(ID), and Savannah River (SC).

A brief description of each site is given, followed by a discussion of the following specific parameters: geology and seismology, hydrology (including water use), water quality, meteorology, aquatic ecology, terrestrial ecology (including land use), socioeconomics, population density, and nearby industrial, military, and transportation facilities. In the context of this analysis, the parameters considered include the following factors or characteristics:

Geology and Seismology--topography, surficial and bedrock geology, regional geology and seismicity.

Hydrology--water availability, flood potential, floodplain encroachment, distance to nearest downstream offsite water user that could be affected by release from the plant, potential water use within 50 miles downstream, river flow available for dilution, and groundwater transport.

The threshold criteria used to evaluate water availability is that the body of water on which the site is located have a once-in-20 year, 30-day low flow rate which is 20 times or more than the evaporative water loss caused by the plant. Because of its small size, the water loss of the CRBRP is small compared to most commercial nuclear plants. The consumptive water use by the plant is about 8 cfs, so the threshold flow rate for the alternative sites is about 160 cfs. Most rivers in the Tennessee Valley would have an adequate water supply because of the extensive regulation provided by dams. Low flow statistics at most of these sites would not be meaningful because of the present regulation of the rivers. Minimum flow levels could probably be maintained at all sites by agreement on operating policy at upstream dams.

The potential for flooding at a site would dictate additional expenses to floodproof safety-related buildings. The plant buildings, or flood protection such as dikes or fill, might encroach on the 100-year floodplain, violating the intent of Executive Order 11988, "Floodplain Management."

The distance to the nearest water user, potential water use, and river flow rate available for dilution are the parameters which would bear on the environmental acceptability of effluents normally or accidentally released from the plant, although normal releases can generally be reduced to very low levels.

A factor R, which is used by the staff to roughly characterize the potential for normal or accidental waterborne radionuclide exposure (e.g., drinking water, fish ingestion, shoreline use, and swimming), was calculated by dividing the population adjacent to the receiving waters in the downstream direction within 50 radial miles of the site by the average annual river flow rate passing the site. Only reconnaissance-level data were used to determine this ratio. This factor is too simplistic to account for the many variables that must be factored into a dose assessment such as dilution along the river, locations and numbers of drinking water users, and fishing and recreational uses; neither does the factor R account for the fraction of the potable water supplied from wells. The factor R must, therefore, be used with caution and interpreted as a gross measurement of aquatic exposure for site comparisons. The staff considers this factor to be adequate, however, for the purpose of reasonably describing the likelihood of such exposures.

The (1970) population adjacent to the Clinch and Tennessee Rivers and downstream (only) within 50 miles of the site can be interpreted to be roughly 41,000 people. The average annual discharge past the site is estimated to be 5380 cfs. Therefore the factor R for the Clinch River site is estimated to be about 7.7 people/cfs.

Aquatic Ecology and Water Quality--short-term or construction phase impacts, including those to any Federally recognized threatened or endangered species that might be present in the area, as a result of site preparation, site runoff, erosion, and inriver construction activities associated with the intake, discharge, barge-unloading facility, and other dredging and filling; and long-term or operational phase impacts, including those to threatened and endangered species, as a result of impingement, entrainment, and thermal and other water quality effects on the receiving water. Further consideration was given to whether the discharge of effluents would require abnormal mitigative controls to comply with state and Federal regulations, or would otherwise adversely affect the efforts of state and Federal agencies to implement water quality objectives.

Meteorology--diffusion conditions (wind speed and direction, atmospheric stability) and extreme storm conditions (tornadoes).

Terrestrial Ecology and Land Use--effects on flora and vegetation, fauna, and existing and proposed uses of the land. These include possible threatened and endangered species on the site and areas specifically designated for environmental or recreational uses. Transmission lines to the sites were not reviewed in detail because none of them is likely to have significantly less environmental impact than at the Clinch River site. As indicated in FES Section 3.8, about 0.5 mile of new right of way would be cleared on site and 2.7 miles of existing right of way would be widened to accommodate the two 161-kV transmission lines that would

connect the CRBRP to the TVA grid; this would affect the biota on about 58 acres of land.

Socioeconomics--displacement or disruption of onsite archeological, historic, scenic, recreational, and cultural resources; displacement of residential and economic activities; anticipated points of vehicular congestion caused by construction worker or truck traffic to and from the site; visual intrusion of station structures in offsite areas; and size and availability of the labor pool. Construction labor in sufficient quantity and within commuting distance has implications for labor migration and consequent demands on community infrastructure (that is, labor inmovement, as distinguished from commutation, is directly related to pressures on community facilities and services) and implications for regional labor shortages. For the alternative site analysis, the staff uses regional availability of labor as a gross indicator of the potential for community-level impacts. To estimate the potential labor pool for each site, 1970 census data were used to determine the percentage of construction workers in the counties within 50 miles of each site. This figure was then applied to 1985 population projections (derived using 1980 and 1990 projections and compound growth rates) to arrive at a labor pool estimate.

Population Density--the total populations and population densities within several radial distances out to 30 miles from each site as determined from 1980 census data; projections of similar information for the years 1990 (planned year of plant startup) and 2030 (estimated end of plant life).

The staff recognizes that, on occasion, population and population density have been used as relatively crude surrogates of the residual risk associated with accidental releases of radioactivity. However, it is clear that the residual risk associated with any accidental releases would depend not only upon the population density of the site, but also upon many other factors that would enter into the determination of the actual consequences of an accident. An assessment has been made of the residual risks of severe accidents at the Clinch River site (Appendix J) and the staff has concluded that these risks are very low.

Regulatory Guide 4.7 (Revision 1, November 1975), "General Site Suitability Criteria for Nuclear Power Stations," provides guidance on consideration of population in alternative sites. It states: "areas of low population density are preferred..." for nuclear power plant sites and continues that if the population density exceeds 500 persons/mi² averaged over any radial distance out to 30 miles at plant startup, or 1000 person/mi² at end of plant life, then special attention should be given to alternative sites with lower population densities. Criterion VI.2.b(7) of the proposed rule on alternative sites (Appendix K) states the same numerical values. The staff, therefore, has used population density as a threshold factor and judges that sites which do not exceed the above trip levels are in areas of low population density, have very low residual risk, and are to be preferred.

Nearby Industrial, Transportation, and Military Facilities--large industrial activities representing fixed sources of explosive or toxic materials; transportation routes in the vicinity such as railroads, highways, and waterways which may carry explosive or toxic shipments; airports within 5 miles and airline routes; and military installations and activities.

Relative Cost To Make the Project Licensable

While information is presented here on geology and seismology, meteorology, hydrology (water availability and flooding potential), and nearby industrial, military and transportation facilities and activities which might affect a nuclear plant, these are matters considered elsewhere as site suitability aspects of safety. All of these candidate sites have been judged (Section 9.2.4.1) to meet criterion (8) in Section VI.2.b. of the Commission's Proposed Rule on Alternative Sites (Appendix K). That criterion indicates that the site should not be in an area where additional safety considerations or environmental considerations for one site compared to other reasonable sites would require the expenditure of substantial additional sums of money (cumulative expenditures in excess of about 5% of total project capital costs to make a project licensable from a safety standpoint or to mitigate unduly adverse environmental impacts). However, for this environmental comparison of alternative candidate sites to the proposed site, the staff also makes a qualitative comparison to determine whether these considerations are likely to require the expenditure of significantly different sums of money to make the project licensable at those sites.

After the Draft Supplement was issued in July 1982, TVA has cancelled two of the four nuclear units being constructed at the Hartsville site and both units being constructed at Phipps Bend. That action has been recognized by appropriate modifications in the following assessments. However, because TVA has "deferred" further construction of two nuclear units that were being built at Hartsville and two units at Yellow Creek, the staff assumed for the purpose of this review that those units may someday be completed. The CRBRP could not be placed on the foundations already in place because of substantial differences in design. The staff has therefore assumed that the CRBRP could be constructed on a previously undisturbed portion of each of those TVA sites, except Murphy Hill. That is probably not possible at Murphy Hill because a proposed synfuel plant would occupy most of the site. Therefore Murphy Hill is considered a surrogate for sites in that general area.

The evaluations in this analysis are based on a combination of literature review, site visits, and map analysis. Table L.1 at the end of this appendix presents a summary of the staff's conclusions.

The TVA sites are discussed first, then the DOE sites. Within each grouping, sites are discussed in alphabetical order. The staff's conclusions are provided at the end of this appendix.

1 TVA SITES

1.1 Hartsville

The Hartsville site is on the north shore of the Old Hickory Reservoir, at Cumberland River Mile 285, in Smith and Trousdale Counties in north-central Tennessee. It is about 5 miles southeast of Hartsville and 40 miles northeast of Nashville. The site consists of 1400 acres of rolling terrain, with surface elevations ranging from 460 to 560 ft msl. The surrounding land is used predominantly for agriculture and forest development. Four 1205 MWe nuclear generating units are partially constructed at this site. The coordinates are 36°21'15" latitude, 86°05'10" longitude.

1.1.1 Geology and Seismology

The Hartsville site is in the Central Stable Region Tectonic Province, which is a region in which a veneer of Paleozoic sedimentary rocks overlies crystalline rocks that have been deformed into arches, domes, and basins by Paleozoic tectonic activity. The controlling earthquakes for the site are based on the postulated occurrence of an MMI VII-VIII earthquake near the site and an MMI XI earthquake 110 miles from the site. The proposed safe shutdown earthquake (SSE) for the LMFBR demonstration plant (0.25 g anchoring the Regulatory Guide 1.60 spectrum) is adequate for vibratory ground motion expected for these events.

The site is on rolling topography at elevation 545 ft msl. From 10 to 20 ft of residual silts and clays overlie bedrock. Rock at the site consists of thin bedded or argillaceous limestone and thick bedded limestone of the Hermitage and Carters formations, respectively. Numerous karst features not identified during earlier investigations were encountered during excavation for Hartsville Units 1 and 2.

Because of the presence of karst features, the unpredictability of their occurrence, and the inability to locate them with standard exploratory techniques, this site is considered slightly less favorable than the Clinch River site with respect to geological considerations and costs associated with licensability. Seismology-related costs would be comparable to those at the Clinch River site.

1.1.2 Hydrology

The Hartsville site has an ample water supply from the Cumberland River; the average summer flow is about 9300 cfs. While this is somewhat more favorable than the CRBRP site, because of the small amount of water required for the demonstration plant (8 cfs), water availability is a relatively insignificant issue.

Plant grade is well above (28 ft), the probable maximum flood (PMF) level of the river and associated wind wave runoff, and encroachment of plant features onto the 100-year flood plain would be minimal. These parameters for Hartsville are approximately equal to those for the CRBRP site.

The site is on fractured and solutioned limestone. A conservative estimate of groundwater travel time to the river is 3 years. There are no public users of groundwater who could be affected, but contaminated groundwater could migrate to the river.

Within 50 miles of the site, there is a sizeable population, some of which uses the Cumberland River for its water supply. The nearest surface water user is 6.5 miles downstream.

The factor R, which is the ratio of the population adjacent to and downstream from the site within 50 miles, to the annual average river flow rate was calculated for the Hartsville site. The (1970) population downstream from the site and adjacent to the Cumberland River is estimated to be 514,000. The annual average river flow at the site is about 17,000 cfs. Therefore, the ratio R is about 30 people/cfs, which is higher than the estimated 7.7

people/cfs at the CRBRP site. The Hartsville site is, therefore, less desirable on the basis of liquid effluent dilution and population served.

Overall, the hydrologic aspects of this site are approximately equal to those of the CRBRP site, including the licensing costs to ensure adequate water supply and flood protection for the plant.

1.1.2.1 Water Quality

The Cumberland River at the Hartsville site is lower in concentration of dissolved solids than is the Clinch River. The Cumberland receives only minor additions of municipal and industrial wastes upstream, and analyses show it to be of high quality. Although the Cumberland is relatively free of the stress of pollution, the river is highly regulated both upstream and downstream by hydroelectric projects; consequently periods of zero flow or even upstream flow occur.

Because of the no-flow periods, the four nuclear units at the Hartsville site were designed to use a multiport diffuser to provide rapid dilution of station discharges. The water depth at the site is about 30 ft, providing a large pool for dilution of the station discharge during the short-duration low-flow periods. Design of the discharge system to accommodate flow from four units would result in poorer mixing when a lesser number of units are operating. Therefore, an intermittent discharge at the full four-unit flow rate was proposed during unit outages to ensure that the diffuser meets design objectives with less than four units operating. To meet water quality standards during periods of zero flow in the river, station discharge would be held in a holding pond.

The State of Tennessee developed effluent criteria specifically for the nuclear units at the Hartsville site. In the Hartsville FES the staff conjectured that the state criterion for suspended solids would be violated regularly and that limits for concentrations of metals could be violated when the evaporative cooling system was operating at high cycles of concentration. The source of the metals is not the plant but the river itself. The assessment of impact concluded that construction and operation of the four 1205 MWe units at Hartsville would result in some small, reversible localized damage to biota. Water quality impacts attributable to the 350 MWe breeder plant would be small compared to those of the Hartsville units and would not appreciably affect the findings of the Hartsville FES.

Because both the Clinch and Cumberland Rivers are characterized by occasional periods of zero flow and might require special mitigative features to protect water quality during such periods, the Clinch River and Hartsville sites are considered comparable. Both sites are on rivers of good quality where, during normal river flow, no water quality impacts would be expected.

1.1.3 Meteorology

Although diffusion conditions at the Hartsville and Yellow Creek sites are slightly better than at the Clinch River site, the staff finds them close enough to be regarded as comparable. Because the meteorological factors for the four TVA candidate sites considered in this appendix are similar, this assessment applies to all four sites. It applies also to the proposed CRBRP site.

Diffusion conditions are generally less favorable in the TVA power service area because of the relatively higher frequency of stable, low-wind-speed conditions than in other areas of the country, based on onsite or nearby offsite meteorological data. This combination of conditions would result in more conservative relative dilution (χ/Q) values being utilized in the evaluation of consequences of routine and accidental releases from nuclear plants at these sites. Light water reactors have been found to be licensable at these sites and at sites in other parts of the country with comparable χ/Q values.

The most important and severe meteorological phenomenon which impacts plant design is the tornado. Based on the guidance in Regulatory Guide 1.76, all of the TVA sites are in Tornado Region I. Locating a nuclear power plant in this region requires a tornado design to withstand the effects of a maximum wind of 360 mph, including impact loading, pressure drop, and missiles.

The staff concluded that licensing costs with respect to meteorology considerations at all of the TVA sites would be comparable to those at the Clinch River site.

1.1.4 Ecology

1.1.4.1 Aquatic Ecology

An LMFBR demonstration plant at the Hartsville site would withdraw water from the Old Hickory Reservoir of the Cumberland River for the closed-cycle cooling system. In support of its application for the Hartsville Nuclear Plants construction permit, TVA studied fishes near the site during 1972-1974. The most abundant species were gizzard shad, carp, and bluegill. Sunfish, black and white crappie, sauger, buffalo, and freshwater drum were also common (NRC, 1975). Based on the density of larval fish in the Cumberland River adjacent to the site, the major fish spawning activity during 1974 extended from late April to mid-August. The most abundant larval taxa taken were clupeids, buffalo (*Ictiobus* sp.) and sunfishes (TVA, 1974). Old Hickory Reservoir is considered to be a major warm-water sport fishery in Tennessee, with the important game species being crappie, large-mouth bass, bluegill, catfish, white bass, rock fish, walleye, and sauger. A commercial fishery exists on the reservoir for buffalo, catfish, and paddlefish. Some mussel harvesting also occurs periodically in the vicinity of the site.

During the fall of 1976, a river bed survey was conducted to determine the presence of Federally protected and threatened or endangered species of freshwater mussels in the vicinity of the Hartsville site. The survey found Lampsilis orbiculata, an endangered species, in a bed adjacent to the site (Isom). The proposed discharge diffuser for the Hartsville units was relocated so it would not significantly impact the mussels in the bed. No other Federally protected threatened or endangered aquatic species is known from the site or vicinity.

Several species of freshwater fish that are considered by the State of Tennessee as endangered or threatened have been taken from the Cumberland River below the falls (TWRC, 1975). However, none have been reported from the site.

The Hartsville site was evaluated for aquatic impacts from two potential siting situations: (1) an LMFBR unit on an uncleared portion of the site of the

existing deferred units and (2) an LMFBF as the only unit operating on the site.

If all four of the Hartsville units were completed, an additional intake would have to be built and the resulting impacts of construction would be comparable to those at the Clinch River site. Because two of the Hartsville units have been cancelled, the LMFBF could probably utilize the resulting excess intake capacity. This would cause little or no impact to aquatic biota as a result of intake construction because little inriver construction relative to that required at the Clinch River site would be necessary. The Hartsville site therefore would be environmentally preferable relative to intake considerations.

The discharge diffuser has not been constructed for the Hartsville units and presumably it could be sized slightly larger to accommodate the additional LMFBF blowdown flow without significant incremental impact. With respect to the impact of construction of the discharge diffuser on aquatic organisms, the two sites are comparable. The potential exists for adversely impacting the freshwater mussel beds at the Hartsville site during construction of the diffuser.

The Hartsville site already has a barge-unloading facility, site preparation has been completed for the licensed units, and site runoff-holding facilities are functional. Additional impacts associated with construction of the barge-unloading facility and site preparation would be minimal. Therefore, with respect to impacts on aquatic ecology from these construction activities, the Hartsville site is environmentally preferable.

In summary, the Hartsville site would be environmentally preferable with regard to construction impacts from the breeder plant on the aquatic ecology since only two of the four Hartsville units will be completed; they would be comparable to those at the Clinch River site if all four Hartsville units were completed. If no Hartsville units were completed, the proposed site would be environmentally preferable to Hartsville with regard to construction impacts.* However, construction-related impacts are temporary, largely mitigable, and can be scheduled so that effects can be even further minimized. The applicants would be required to implement an approved erosion-control plan prior to construction. Although preferability of one site over another can be established for construction-related impacts, the staff finds, based on the above, that the importance of this preferability in the evaluation of alternatives is minor.

The impacts of plant operation on aquatic biota at the Hartsville site as a result of impingement, entrainment, and the thermal plume were also analyzed.

The Hartsville intake may result in significant losses of paddlefish, Polyodon spathula. TVA has experienced large numbers of young-of-the-year paddlefish impinged on the intake screens of the Gallatin steam plant, which is located downstream on the same reservoir (Pasch et al., 1980). Spawning is known to occur upstream of the Hartsville site. Entrainment losses of this species may

*These judgments are made primarily on the basis of the intake- and diffuser-related impacts.

also be a problem. Based on this potential for impact, the staff concludes that the proposed site is environmentally preferable to the Hartsville site with respect to impingement and entrainment losses under any plant configuration at the Hartsville site.

The additional thermal loading from an LMFBR at the Hartsville site if the deferred Hartsville units are also completed would not result in an adverse impact to aquatic biota inhabiting the Cumberland River. The Hartsville site was originally reviewed for four 3579 Mwt units and found acceptable (NRC, 1975), whereas the thermal discharge of an LMFBR at the Clinch River site has the potential, under low- or no-flow conditions in the Clinch River, to impact striped bass that utilize that stretch of river as a thermal refuge during the late summer and early fall (see Sections 2.7.2 and 5.3.2.2). Should studies conducted by the applicants prior to plant operation fail to conclusively demonstrate that impact to striped bass will not occur, the applicants have committed (Longenecker, 1982) to restricting the thermal discharge from the CRBRP during periods when the river water temperature is high and zero flow conditions exist. Furthermore, EPA, in the draft NPDES Permit (III.M, see Appendix H), will require that no thermal impact to striped bass occur because of plant operation. Thus the Hartsville site is considered to be environmentally comparable to the Clinch River site with respect to the potential for impact on aquatic biota as a result of thermal discharge.

The staff concludes overall that the Clinch River site is environmentally comparable or environmentally preferable to the Hartsville site under any plant configuration with respect to the impact of construction and operation on the aquatic biota inhabiting the source and receiving water bodies.

1.1.4.2 Terrestrial Resources

There are no Federal lands or natural landmarks on or near the Hartsville site. While there are approximately 13 recreation areas within 10 miles of the site, none are on site, neither are there any privately dedicated areas on or near the site. The Old Hickory Wildlife Management Area is about 10 miles east-southeast of the site.

Before construction activities for the Hartsville units began, approximately 90% of the site was used for agricultural purposes. As a result, there was little diversity of herbaceous and woody plant species, and the site did not provide a diverse wildlife habitat. Ongoing construction activities have further reduced the desirability of this site for wildlife. No Federally listed endangered or threatened species have been known to frequent the site. Before site construction activities began, eight state endangered species were observed at or near the site. None of these species appeared to be utilizing the site for nesting activities. The staff concludes that additional construction activities associated with the possible location of an LMFBR at Hartsville would not significantly affect remaining populations on this site.

Of the 90% of the site that was used as farmland, much could be classified as "prime farmland." However, with ongoing construction activities, there are no agricultural operations on the site.

Several small wetland areas on the site are primarily the result of construction activities.

Assuming that the demonstration plant is placed on an undisturbed portion of the site, Hartsville would offer no substantial advantage over the Clinch River site in terms of impacts on terrestrial resources. This judgment recognizes that the staff has already found that the terrestrial resources on the Clinch River site are not unique and that impacts on them from construction and operation of CRBRP would be small. However, if some cleared portion of the Hartsville site becomes available and can be used for the LMFBR plant, this site would be preferable in terms of impacts to terrestrial resources.

1.1.5 Socioeconomics

No cultural, scenic, or recreational areas are located at the Hartsville site.

Only one site within 10 miles of the plant site is listed in the National Register of Historic Places. It is the Tilman Dixon house ("Dixona"), built in 1788-1789 and located less than 1 mile from the site. Two additional structures of historic interest were also originally found on site. The Wright-Oldham house is a frame house dating from the mid-19th century, and the John McGee house is a two-story brick structure from the early 19th century. The McGee house was located in an area where construction of the Hartsville nuclear units has occurred.

Archeological investigation of the Hartsville site has revealed that it is a relatively rich archeological location (NUREG-75/039). Thus, building a breeder reactor there in addition to one or more commercial units would likely disrupt onsite resources. The Clinch River site is preferable in this regard.

Some residents were relocated and some agricultural land was preempted before construction began on the four commercial units. The use of additional land needed on the Hartsville site to accommodate an LMFBR would not require further displacement. Therefore, Hartsville is comparable to the Clinch River site in this respect.

Tennessee Highway 25 is the main roadway that would be used by the construction force. The lack of optional roadways indicates that the Hartsville site may be subject to more traffic congestion than would occur at the Clinch River site. Thus, the Clinch River site is preferable in this regard.

Some of the construction at the Hartsville site had proceeded considerably before work was stopped. As a result, the addition of a breeder reactor would offer less visual intrusion than at the Clinch River site.

An estimated 29,674 people will be available for construction work in 1985 in the area around the Hartsville site. Although this figure is larger than the labor force estimated to be available in the region around the proposed CRBRP site, the distribution of labor differs substantially. Most of the workers in the labor pool serving the CRBRP site would commute from Knoxville, which is within 30 miles. At Hartsville, most of the labor pool is concentrated around Nashville, which is in the 40-to-50-mile ring around the station. Moreover, approximately three times the number of construction workers live within 30

miles of the CRBRP site, compared to the number that live within 50 miles of Hartsville. For these reasons, Hartsville is less desirable than the CRBR site in terms of labor availability.

In summary, assuming the construction of the CRBRP on the Hartsville site, either simultaneously or not during the same time frame as construction of one of the commercial units, the staff concludes that the socioeconomic impacts at Hartsville would be less desirable than those at Clinch River. This evaluation arises because of the relatively unfavorable traffic congestion patterns and levels of construction labor.

1.1.6 Population Density

Population totals and projections in the vicinity of the Hartsville site are as follows:

Distance from site (mi)	1980		1990		2030	
	Total population	Density (persons/mi ²)	Total population	Density (persons/mi ²)	Total population	Density (persons/mi ²)
0-5	2,765	35	3,110	40	5,771	73
0-10	13,160	42	14,865	47	27,521	88
0-20	69,930	56	82,335	65	262,151	209
0-30	158,266	56	185,635	66	481,129	170

Comparable data for the proposed CRBRP site* are

Distance from site (mi)	1980		1990		2030	
	Total population	Density (persons/mi ²)	Total population	Density (persons/mi ²)	Total population	Density (persons/mi ²)
0-5	5,713	73	6,807	87	8,925	114
0-10	56,570	180	65,322	208	84,296	268
0-20	209,870	167	209,922	167	230,996	184
0-30	521,070	184	557,522	197	624,996	221

*Includes transient population for 0-10 miles.

Although the data indicate that the total population and population densities are lower at this alternative site than at Clinch River, both sites have population densities which are well below the threshold values of Regulatory Guide 4.7 and criterion VI.2.b(7) of the proposed rule on alternative sites and, therefore, both sites are in areas of low population density.

The staff concludes that, despite actual differences in population density, the residual accident risks are not expected to be significantly different and would be very low at either site. Consequently neither site is considered to be environmentally preferable compared to the other with regard to population density.

1.1.7 Industrial, Military, and Transportation Facilities

There are no chemical plants or other industries processing hazardous materials in the vicinity of the site. The closest industries are several manufacturing plants located in Hartsville, approximately 5 miles northwest of the site, that produce clothing, footwear, and other fabricated products. There are no military bases or activities in the vicinity of the site.

At present, there is no barge traffic past the site on the Cumberland River. Some hazardous materials, such as gasoline, are transported on a state highway approximately 4000 ft from critical plant structures. However, the expected low frequency of hazardous material shipments, plus the separation distance from the highway to critical plant structures, is adequate to ensure that these shipments will not interfere with the safety of a nuclear plant.

There are no airports within 15 miles of the site, but there are two low-level airways which intersect within 2 miles of the site. Based on data and analysis submitted by TVA, the staff previously concluded that the probability of an aircraft crashing into a reactor at the Hartsville site is acceptably low (less than about 10^{-7} year) and within the acceptance criteria of Standard Review Plan Section 2.2.3 (NUREG-0800); thus it need not be provided for in the design of the facility.

A 22-in. natural gas pipeline traverses the exclusion area approximately 2650 ft from safety-related structures. A compressor station for this pipeline is located about 3400 ft northwest of the nearest plant structure. During the CP application for the Hartsville plant, the staff reviewed TVA's analysis and concurred that this pipeline represents no undue threat to the safe operation of a nuclear plant at the Hartsville site.

The staff concluded that no significant additional expenditures would be necessary to make the breeder plant licensable at the Hartsville site in regard to this parameter.

1.2 Murphy Hill

The Murphy Hill site is located in Marshall County, Alabama, on the southern bank of Guntersville Lake on the Tennessee River, about 25 miles southeast of Huntsville and 12.5 miles northeast of Guntersville. It consists of approximately 1200 acres, most of which has been cleared for construction of a proposed coal gasification project. Because there is probably not room for both the synfuel plant and the breeder plant on this site, the staff considered it as a surrogate for similar sites in the vicinity.

The coordinates are 34°29'00" latitude, 86°10'00" longitude.

1.2.1 Geology and Seismology

The Murphy Hill site is in the southern part of the Valley and Ridge Tectonic Province. The site is on a small peninsula in Gunter'sville Reservoir. The peninsula is formed by a northeast elongated hill ranging in elevation from about 595 ft msl at the lakeshore to 680 ft msl at the top of the hill.

The site is underlain by limestone, siltstone, and shale of the Ordovician Chickamauga formation. Foundations will be within approximately the same stratigraphic horizon as that of the Bellefonte plant. Like Bellefonte, Murphy Hill is on the southeast flank of the Sequatchie anticline. The Sequatchie fault is on the northwest flank of the Sequatchie anticline. The fault is a major southeast-dipping, low-angle thrust fault that formed during the Paleozoic Era along with other thrust faults throughout the Valley and Ridge Province. Several solution cavities were found in borings at the site, along with a possible northwest-trending minor fault.

The Murphy Hill site is in the same tectonic province as the proposed CRBRP site; therefore, the seismic exposure is the same. Faults in the vicinity of both sites are similar in age and physical characteristics. Foundation conditions of the Clinch River and Murphy Hill sites are similar. Thus, the Murphy Hill site is considered to be equivalent to the proposed site from the standpoint of geology and seismology; the related costs of licensing would therefore be comparable to those at the Clinch River site.

1.2.2 Hydrology

The Murphy Hill site has ample water supply from Gunter'sville Lake on the Tennessee River. The annual average flow at the site is estimated to be 39,000 cfs, which is more than the flow at the Clinch River site. However, because of the small amount of water required for the proposed LMFB, water availability is a relatively insignificant issue.

Plant grade is estimated to be 621 feet msl, and the PMF is estimated to be about 2 ft below plant grade. Minimal flood protection would be needed, and there would probably be little, if any, encroachment on the 100-year flood plain because of plant construction. For this parameter, the Murphy Hill and Clinch River sites are equal.

The site is located over fractured dolomite. Groundwater occurs in fractures and solution cavities and flows toward Gunter'sville Lake. The potential for groundwater transport of releases does not appear to be a problem, and thus is judged to be equal to the potential at the Clinch River site.

The (1970) population within 50 miles of the site adjacent to the Tennessee River and in the downstream direction is estimated to be 350,000 people. The ratio of people potentially served to river flow rate is therefore $350,000/39,000$, or approximately 9 people/cfs, which is slightly higher than the 7.7 people/cfs for the Clinch River site. The Murphy Hill site is therefore slightly less desirable on the basis of liquid effluent dilution and population served.

Overall, the Murphy Hill site is considered approximately equal to the proposed site in regard to hydrology concerns. The costs to provide adequate water and flood protection for the plant would be approximately the same for the two sites.

1.2.2.1 Water Quality

Guntersville Lake has lower concentrations of dissolved inorganics than does the Clinch River, is generally of fair quality although the reach downstream of the Murphy Hill site near the dam is highly productive, and is approaching its capacity to assimilate organic wastes. Water temperatures in the impoundment approach the Alabama maximum criterion of 30°C, and dissolved oxygen levels below the Alabama criterion of 5.0 mg/l have been observed in the site vicinity.

Although flow into and out of the lake is regulated for hydroelectric power generation and flow past the site may be zero for as long as 12 hours at a time, longer term flows past the site are so high (the minimum daily flow is 2900 cfs, and the 7-day, 10-year low flow is 11,000 cfs) that they ensure there will be no long-term impacts on water quality from a project the size of the CRBRP. Furthermore, the Guntersville Lake provides a large volume of dilution water for reducing effluent concentrations during the short no-flow periods.

Water quality concerns in the coal gasification plant review (TVA, 1981) were principally related to the capacity of Guntersville Lake to assimilate additional organic wastes. Additional concerns were associated with potentially toxic wastes unique to the coal gasification project. Discharge of waste heat and contaminants of the type which would result from an LMFBR posed no special concerns. The combination of the large river flow relative to the CRBRP requirements and the nature of the discharges from the CRBRP ensure that the Murphy Hill site could accommodate the project without impact.

In comparison to the Clinch River site, Murphy Hill has the advantages of greater dilution flow and somewhat lesser concern over thermal impacts. However, because impacts as a result of water quality changes at the proposed site are judged to be negligible, these Murphy Hill advantages do not weigh heavily in the comparison of alternatives.

1.2.3 Meteorology

The meteorological considerations for Murphy Hill are similar to those for the Hartsville and Clinch River sites (see Section 1.1.3 above).

1.2.4 Ecology

1.2.4.1 Aquatic Ecology

An LMFBR at the Murphy Hill site would withdraw and discharge water to Guntersville Lake for the closed-cycle cooling system.

TVA studied fishes in the vicinity of the Murphy Hill site from December 1976 through November 1977. Gizzard shad, bluegill, red-ear sunfish, yellow bass, sauger, and channel catfish were the dominant species (TVA, 1981). Abundant spawning and nursery areas were found in the overbank areas, primarily associated with thick milfoil growth. Shad comprised over 90% of all larval fish taken during the survey. Sport fishing is concentrated in milfoil beds in the coves and overbank areas and is heaviest during the spring. Bluegill and red-ear sunfish comprise approximately 80% of the total catch. Some commercial fishing in the area is known (ibid).

A number of aquatic species worthy of protection are known (Freeman et al., 1979; Boschung, 1976) or suspected at the site; they are Isoetes engelmannii, a quillwort; Elodea canadensis, also an aquatic plant; and Cambarus hamulatus, a crayfish. The status of these species has not been officially recognized by the State of Alabama, and the state currently has no legislation that provides for protection of these species.

The range of 14 species of Federally recognized threatened or endangered aquatic freshwater mussels includes the Murphy Hill site. Qualitative surveys were conducted in 1977 and 1980 to determine the distribution of molluscs in the vicinity of the site. No threatened or endangered species were found (TVA, 1981).

In this assessment of the Murphy Hill site for aquatic impacts as a result of the construction and operation of an LMFBR, it was assumed that the LMFBR intake would be similar to that proposed for the coal gasification project: an open channel, two vertical traveling fine-mesh screens (0.5-mm openings), and a fish return system (ibid). The discharge structure was assumed to be similar to that proposed for the Clinch River site (see Section 3.4.3). Impacts associated with construction of the intake and discharge structures at the Murphy Hill site were judged to be potentially more harmful than at the Clinch River site. The importance of the overbank area as a nursery for fishes and the occurrence of the aquatic plant I. engelmannii along the shoreline of the Murphy Hill site have the potential for some temporary impact to aquatic species.

Because site runoff-holding facilities are already in place and most of the site preparation is completed at the Murphy Hill site, the staff finds the Murphy Hill site would be environmentally preferable with respect to these two factors if the LMFBR plant were to be constructed on the site instead of the coal gasification plant.

Overall, the staff finds that the Murphy Hill site, as an undisturbed surrogate, would be less desirable than Clinch River with respect to impacts on aquatic biota as a result of construction of an LMFBR.

The impacts on aquatic biota as a result of plant operation at the Murphy Hill site were analyzed by TVA during the preparation of the coal gasification plant impact statement (ibid). No significant impacts on aquatic biota were determined despite facility makeup flow and blowdown rates three and four times (respectively) those anticipated for an LMFBR. A properly designed intake for an LMFBR at the Murphy Hill site would result in negligible impingement and entrainment losses. This is comparable to the losses predicted for the Clinch River site.

The additional thermal loading from an LMFBR at the Murphy Hill site would not result in an adverse impact to aquatic biota inhabiting Guntersville Lake. The thermal discharge of an LMFBR at the CRBRP site has the potential, under low- or no-flow conditions in the Clinch River, to impact striped bass that utilize that stretch of river as a thermal refuge during the late summer and early fall

(see Sections 2.7.2 and 5.3.2.2). Should studies conducted by the applicants prior to plant operation fail to conclusively demonstrate that impact to striped bass will not occur, the applicants have committed (Longenecker, 1982) to restricting the thermal discharge from the CRBRP during periods when the river water temperature is high and zero flow conditions exist. Furthermore, EPA in the draft NPDES Permit (III.M, see Appendix H) will require that no thermal impact to striped bass occur because of plant operation. Thus, the Murphy Hill site is judged environmentally comparable to the Clinch River site with respect to the potential for impact on aquatic biota as a result of the discharge.

The staff concludes that an LMFBR at the Murphy Hill site would be environmentally comparable to an LMFBR at the Clinch River site with respect to the impact of construction and operation on the aquatic biota inhabiting the source and receiving water bodies.

1.2.4.2 Terrestrial Resources

There are no Federal lands or natural landmarks on or near the site, and there are no state or local parks on site. Recreation developments within 10 miles of the site are: (1) Lake Guntersville State Park and Bucks Pocket State Park; (2) two local parks (ER-CP, Appendix A, A-17); and (3) one wildlife management area. No privately dedicated areas are on or near the site, nor are there any critical habitat areas on or near the site.

Of the approximately 1200 acres on the site, one-third was farmland and two-thirds forested. The most common tree species were loblolly pine, Virginia pine, chestnut oak, and shagbark hickory. At the time of the staff site visit, the site had largely been cleared for planned construction of the coal gasification facility.

The site contained a rich diversity of fauna. It was estimated (ER-CP, Appendix A) that there were 123 terrestrial vertebrate species on the site. No rare, unique, or endangered species have been observed at the site.

Parts of the open area on the site were cultivated fields and pastures (370 acres). Based on a preliminary review by the staff, some of this acreage may be classified as "prime farmland." There are no wetlands on the site.

Although most of the clearing activities have already occurred at Murphy Hill for another planned use, the staff considered placing the LMFBR on Murphy Hill as though it were on an uncleared portion of the site, or on a nearby site possessing similar terrestrial resources. From its review of reconnaissance-level information on the terrestrial resources of Murphy Hill, the staff concludes that both this alternative and the Clinch River site have terrestrial resources characteristics that are not unique or unusual for the region. Because there are no significant differences between these sites, the staff finds that neither site is preferable to the other in terms of impacts to terrestrial resources. However, if construction of the coal gasification project does not proceed, then construction on a cleared portion of the Murphy Hill site would be preferable to clearing the Clinch River site.

1.2.5 Socioeconomics

No recreation facilities exist on the site, although two state parks are located in the vicinity (TVA, 1981). No unique or unusual scenic features have been identified on the site (ibid).

No historic resources exist on the site, although the Walker Jordan cabin (the oldest existing log cabin in Marshall County) is located about 0.5 mile south-east of the site. This cabin may be eligible for inclusion in the National Register (ibid).

A 1973 archeological survey of the site revealed four archeological sites, one of which warranted further investigation. It was concluded that no adverse impacts would occur from construction (ibid).

The Murphy Hill area does not possess abundant cultural resources. It is unlikely that siting a reactor in the general vicinity would displace or disrupt these resources. This situation is comparable to the Clinch River site.

No residents are present on the property; however, about 30% of the land at the Murphy Hill site was previously classified as prime farmland (ibid). Additional land would be required to build an LMFBFR here because the coal gasification project would use most of the site. As this would likely preempt more farmland, the Murphy Hill site is less desirable than the Clinch River site in this regard.

Highway access to the site is from River Road, a paved two-lane county road. No main highway leads to the area (ibid) and several miles of road improvement were needed from the site to U.S. Highway 431. Heavy congestion would be expected on State Route 227, especially in Lake Guntersville State Park during peak construction traffic hours (ibid).

There appear to be few roads linked to the remote Murphy Hill site. Construction traffic is likely to pose more problems than at Clinch River.

If an LMFBFR were built close to the gasification facility, the added visual intrusion of the reactor would be less than the intrusion that would be introduced at the Clinch River site. The Murphy Hill site is therefore preferable on that basis; however, because no construction would have taken place at either site, visual intrusion would be roughly comparable at the Murphy Hill and Clinch River sites.

The staff estimates a 1985 potential labor pool of 19,058 around the Murphy Hill site. This figure is less than the number of individuals in the construction industry in the vicinity of the Clinch River site. In this regard, construction of an LMFBFR at Murphy Hill would be less desirable than construction at the Clinch River site.

Overall, Murphy Hill was judged to be less desirable than Clinch River in terms of socioeconomic impacts.

1.2.6 Population Density

Population totals and projection in the vicinity of the Murphy Hill site are as follows:

Distance from site (mi)	1980		1990		2030	
	Total population	Density (persons/mi ²)	Total population	Density (persons/mi ²)	Total population	Density (persons/mi ²)
0-5	2,508	32	3,035	39	4,655	59
0-10	8,505	27	10,294	33	15,786	50
0-20	90,192	72	109,158	87	167,403	133
0-30	240,871	85	291,522	103	447,076	158

Comparable data for the proposed CRBRP site are given in Section 1.1.6.

Although the data indicate that the total population and population densities are lower at this alternative site than at Clinch River, both sites have population densities which are well below the threshold values of Regulatory Guide 4.7 and criterion VI.2.b(7) of the proposed rule on alternative sites, and, therefore, both sites are in areas of low population density.

The staff concludes that, despite actual differences in population density, the residual accident risks are not expected to be significantly different and would be very low at either site. Consequently, neither site is considered to be environmentally preferable compared to the other with regard to population density.

1.2.7 Industrial, Military, and Transportation Facilities

The Murphy Hill site lies on a portion of the Guntersville Lake that is a navigable waterway. The 1978 barge traffic on the Tennessee River to and from Chattanooga was over 1.5 million tons.

The closest airport is a single hard-surfaced runway at Guntersville, Alabama, approximately 9 miles southwest of the site. The closest airway is about 9 miles west of the site.

The closest industrial area to the site is the Monsanto Plant 5 miles downstream; this plant was closed in 1981. Recreational activities within a 10-mile radius of Murphy Hill are lake oriented and include boating, water skiing, fishing, and camping.

There are no pipelines or railroads within 5 miles of the Murphy Hill site. The nearest currently used road is about 1.25 miles east of the site, across a ridge 200 ft higher than the site. State Route 79 is on the opposite shoreline of Guntersville Lake, approximately 1.5 miles west of the proposed reactor site.

Assuming that the breeder plant were built on the Murphy Hill site in lieu of the coal gasification plant, the staff concluded that no significant additional expenditures would be necessary to make the breeder plant licensable in regard to this parameter. However, if both facilities were constructed in the same vicinity, further analysis would be necessary to make a determination.

1.3 Phipps Bend

The Phipps Bend site is located in Hawkins County, Tennessee, on the right bank of the Holston River, approximately 2.5 miles east of Surgoinsville and 60 miles northeast of Knoxville. Two 1220-MWe nuclear units are partially constructed on the 1270-acre site. The coordinates are 36°27'47" latitude, 82°48'32" longitude.

1.3.1 Geology and Seismology

The site is located in the southern Valley and Ridge Tectonic Province, which consists of major northeast-trending folds and east-dipping thrust faults. The site is at a bend on the Holston River at an average surface elevation of 1180 ft msl. The area is covered by 13 to 64 ft of terrace deposits and residual soil. The plant would be founded on Sevier shale bedrock of Middle Ordovician Age. Like the CRBRP site, major thrust faults, which have been shown to be at least 240 million years old, are mapped in the site vicinity. Numerous minor faults have been mapped in excavations for the Phipps Bend Units 1 and 2 sites; these have been shown to be not capable according to Appendix A to 10 CFR 100.

Because the Phipps Bend site is in the same tectonic environment as the CRBRP site and there are no significant potential foundation problems, it is considered to be equal to the CRBRP site in regard to geology and seismology and the associated licensing costs would be comparable.

1.3.2 Hydrology

The Phipps Bend site is located on the Holston River in Tennessee, which would provide adequate water for the plant. The annual average flow rate past the site is about 3600 cfs, which is the smallest for any of the TVA candidate sites. It is less favorable than the flow at the CRBRP site, but because of the small amount of water required for the proposed plant, water availability is a relatively insignificant issue.

Plant grade would be at about 1175 ft msl, which is about 65 ft above the normal floodplain of the river. The PMF level is about 1183 feet msl. Some flood protection may be necessary at the site, but probably not in the 100-year floodplain. This is the only one of the alternative sites that might need such protection, but it could probably be accomplished, if necessary, with little difficulty and expense.

The (1970) population adjacent to the Holston River within 50 miles downstream from the site is estimated to be about 93,000 people. The ratio of persons potentially served to the flow rate past the site is therefore 93,000/3600, or approximately 26 people/cfs, which is higher than the R factor of 7.7 people/cfs for the Clinch River site. On the basis of dilution of liquid effluents and the population served, this site is less desirable than the Clinch River site.

The site is located on consolidated rocks (dolomite, limestone, shale, and sandstone). Groundwater transport to the Holston River would be slow, and, as with the other sites, the transport of radioactivity through the groundwater to adjacent rivers does not appear to be a problem.

Overall, in regard to hydrology, this site is slightly less desirable than the proposed CRBRP site and a small additional cost might be involved in making the plant licensable with respect to flood protection.

1.3.2.1 Water Quality

The FES for the Phipps Bend Nuclear Plant (PBNP) (NUREG-0168) described the water of the Holston River as having a relatively low mineral content and cool temperatures but showing signs of the stresses of heavy loadings of industrial and domestic wastes. At times upstream from the plant, low dissolved oxygen concentrations occur that are primarily attributable to organic waste loadings. The maximum average monthly temperature in the river is 82°F and it occurs in July. Short duration local maxima as high as 88°F have been reported. TVA maintains a minimum average daily flow of 750 cfs in the river, in accordance with terms of an agreement with the Tennessee Eastman Company, for dilution of waste discharges.

The small river flow relative to the water requirements of PBNP causes concern over water quality in the immediate vicinity. The two 1220 MWe light water reactors, which have been cancelled, would have caused a localized deterioration of water quality. However, after complete mixing of the effluent with the river flow, the net effect of the two units would be insignificant. The additional effluent from the 350 MWe breeder plant would not alter that conclusion. The only organic loading to the river from the station, including the breeder, will be the effluent from the sanitary waste treatment system. Because of the level of treatment required by the NPDES Permit, this effluent will not add to existing water quality problems.

Because the Holston River is shallow at the site, a multiple-port diffuser was designed to disperse cooling tower blowdown quickly. With the diffuser, temperature standards could be met with an acceptable mixing zone. However, the FES concluded that, even with the diffuser, stringent limits on the discharge of copper and chlorine should be imposed. The FES further concluded that, with such limitations in the NPDES Permit, the site could accommodate the two PBNP 1233 MWe units with no significant impact to water quality. The addition of the 350 MWe breeder unit would result in a larger mixing zone but, with comparable discharge limitations, it would be accommodated with still small water quality impacts.

During construction the Holston River has been very well protected from the impact of silt. Construction impacts resulting from adding the breeder probably would also be negligible.

Water at the Clinch River site is of comparable quality to that in the Holston with regard to dissolved mineral conduct and does not have the stresses of waste loadings. Because of the slightly greater depth at the Clinch River site, and because of the lower flow from the smaller breeder reactor, the problem of

dispersion of the discharge with river water is more easily resolved. However, during those short time periods when flow in the Clinch River is zero, water quality in the immediate vicinity of the discharge would deteriorate. Such occurrences would be infrequent, of short duration, and highly localized. Therefore, in this regard, the Phipps Bend and CRBRP sites are comparable.

With controls in the NPDES Permit for the Clinch River site that eliminate potential impacts during abnormally low flow conditions, the Clinch River site has a slight overall siting advantage with regard to water quality.

1.3.3 Meteorology

The meteorological considerations for Phipps Bend are similar to those for the sites discussed above and the Clinch River site (see Section 1.1.3 above).

1.3.4. Ecology

1.3.4.1 Aquatic Ecology

An LMFBF at the Phipps Bend site would withdraw and discharge water from the Holston River for the closed-cycle cooling system.

TVA studied fish populations within a 10-mile stretch of the river near the site in support of the PBNP construction permit application (TVA, 1976). The dominant taxa collected were gizzard shad, suckers, sunfish, and minnows (NRC, 1977). Larvae of suckers, minnows, catfishes, sunfish, perches, and shad were collected in the vicinity of the site. A creel census found that 90% of the sport harvest is sunfish and that recreational fishing pressure is apparently low near the site. There is no commercial fishing in the vicinity of the site. The aquatic community in the Holston River near the Phipps Bend site is probably adversely affected by a number of factors, including upstream discharges, low dissolved oxygen, and fluctuations in water level and temperature because of an upstream reservoir.

No Federally protected threatened or endangered aquatic species are known to occur in the vicinity of the site. No aquatic species taken near the site are classified as endangered or threatened by the State of Tennessee (TRWC, 1975).

The Phipps Bend site was evaluated from the standpoint of two siting situations: an LMFBF unit with the existing two deferred units completed and an LMFBF unit as the only operating unit on the site. The Phipps Bend site was compared to the preferred site with regard to impacts to aquatic biota associated with plant construction and operation.

If both Phipps Bend units were completed, an additional intake would have to be built and the resulting impacts of construction would be comparable to those at the Clinch River site. However, both of the Phipps Bend units have been cancelled, and the LMFBF could probably utilize the existing intake capacity. This would cause little or no impact to aquatic biota as a result of intake construction because little inriver construction relative to that required at the Clinch River site would be necessary. The Phipps Bend site would then be environmentally preferable to the Clinch River site with respect to intake construction.

The discharge diffuser has not been constructed for the Phipps Bend station and presumably it could be sized slightly larger to accommodate the additional LMFBF blowdown flow without significant incremental impact. With respect to the impact of construction of the discharge diffuser on aquatic organisms, the Phipps Bend and Clinch River sites are comparable.

Site preparation has been completed for the Phipps Bend units and site runoff-holding facilities are functional. Aquatic impacts associated with additional site preparation for the breeder at the Phipps Bend site would probably be minimal; therefore, with respect to these construction activities, the Phipps Bend site is environmentally preferable to the Clinch River site.

Overall, the Phipps Bend site was found to be environmentally preferable with respect to construction impacts to aquatic biota whether both Phipps Bend units were completed or not. However, construction-related impacts are temporary, largely mitigable, and can be scheduled to further minimize effects. The applicants will be required to implement an approved erosion-control plan prior to construction. Although preferability of one site over another can be established for construction-related impacts, the staff finds, based on the above, that the importance of this preferability in the evaluation of alternatives is minor.

The impacts on aquatic biota of plant operation at the Phipps Bend site as a result of impingement, entrainment, and the thermal plume were also analyzed. Either the current intake or a properly designed new intake at the Phipps Bend site would result in negligible impingement and entrainment losses comparable to those at the Clinch River site. However, the impact to aquatic biota in the Holston River because of the combined thermal plume from the LMFBF and both Phipps Bend units may be unacceptable; therefore, under this siting situation, the Clinch River site is environmentally preferable.

With neither or only one of the Phipps Bend units operating, the additional thermal loading associated with an LMFBF at Phipps Bend would not result in impacts to aquatic biota, whereas the thermal discharge of an LMFBF at the Clinch River site has the potential, under low- or no-flow conditions in the Clinch River, to impact striped bass that utilize that stretch of river as a thermal refuge during the late summer and early fall (see Sections 2.7.2 and 5.3.2.2). Should studies conducted by the applicants prior to plant operation fail to conclusively demonstrate that impact to striped bass will not occur, the applicants have committed (Longenecker, 1982) to restricting the thermal discharge to Clinch River during periods when the river water temperature is high and zero flow conditions exist. Furthermore, EPA in the draft NPDES Permit (III.M; see Appendix H) will require that no thermal impact to striped bass occur because of plant operation. Thus, if the breeder were operating simultaneously with neither or only one of the commercial units, the Phipps Bend site is judged environmentally comparable to the Clinch River site with respect to the potential for impact on aquatic biota as a result of the thermal discharge.

The staff concludes that locating an LMFBF at the Phipps Bend site with neither or only one of the Phipps Bend units completed is environmentally comparable to the Clinch River site with respect to the impact of construction and operation on the aquatic biota inhabiting the source and receiving water body. If, however, both Phipps Bend units are completed, the siting of an LMFBF at the same

site may result in significant impacts to Holston River biota; therefore, under this siting configuration, the Clinch River plant is environmentally preferable.

1.3.4.2 Terrestrial Resources

No Federal lands or natural landmarks are located on or near the site, and there are no state or local parks on site. Panther Creek State Park (Hamlin County) is about 35 miles southwest of the site, and Warriors Path State Park is about 20 miles to the east-northeast. There are no state forests in the area.

No privately dedicated areas are on site. There are, however, approximately 10 private recreational sites in Hawkins County (the county in which the Phipps Bend site is located).

There are no critical habitat areas on or near the site. The John Sevier Wildlife Management Area is 10 miles southwest of the site.

The vegetation of the Phipps Bend site is highly disturbed, strongly reflecting the effects of relatively intense land-use activities, including the construction of a commercial nuclear power generating facility. Previously, the land at the site was used primarily for pasture and cropland.

Some of the site wildlife habitat has been disturbed by construction activities. Terrestrial game species possibly still occurring at or near Phipps Bend include the grey squirrel, cottontail rabbit, bobwhite quail, ruffed grouse, and mourning dove. Furbearers may include red and grey fox, skunk, opossum, weasel, woodchuck, mink, and muskrat. The woodduck is the most abundantly occurring waterfowl species at the site. No Federally endangered or threatened species have been recorded on the site.

Five state listed species have been occasionally noted on the site (NUREG-0168).

There is no active agricultural operation onsite. Of the 1270 acres of the existing site, approximately 400 acres are estimated by the staff to be potentially classifiable "prime farmland."

Onsite riparian habitat exists along the Holston River. Small, productive wetland areas have been developed on the site as a result of controlled construction runoff.

The site's terrestrial resources have been impacted by construction activities related to PBNP. Thus, because of the already disturbed nature of the site and the lack of any identified unique or unusual terrestrial resources at Phipps Bend, the staff concludes that the Phipps Bend site would be slightly preferable to the Clinch River site in terms of the potential reduction of impacts to the region's terrestrial resources, although this reduction would be slight for either site.

If the LMFBR plant were placed on an undisturbed area of Phipps Bend site, the site would offer no substantial advantage in terms of impacts on terrestrial resources. This judgment recognizes that the staff has already found that the

terrestrial resources on the Clinch River site are not unique and that impacts on them from construction and operation of the CRBRP would be small. However, if some cleared portion of the site becomes available, this site would be preferable in terms of impacts on terrestrial resources.

1.3.5 Socioeconomics

No designated "scenic rivers" or other recreational areas are located on the Phipps Bend site. The closest cultural area is the birthplace of Davey Crockett, 20 miles away.

Several historic landmarks are located within 10 miles of the site. The closest is Stony Point, the oldest brick house in Hawkins County, which is 2 miles from Phipps Bend. No historic landmarks have been located on site. Several archeological sites have been found on site, but the Advisory Council on Historic Preservation has found that current construction will not impact them (NUREG-0168).

Onsite resources appear sufficiently limited so as to make Phipps Bend comparable to the Clinch River site in this respect.

No additional land purchases would be needed, and no displacement would occur. Therefore, the Phipps Bend site is comparable to the Clinch River site with respect to displacement of residential and economic activities.

The site is accessible from U.S. Highway 11W (NUREG-0168). Construction traffic could cause congestion, a longer period of peak traffic in Kingsport, and additional problems in Hawkins County. Assuming simultaneous construction at the Phipps Bend commercial station, breeder construction traffic would further impact an already burdened traffic network. This situation would be less desirable than the Clinch River site, which has a more extensive road system available. If the PBNP units are not constructed simultaneously with the breeder reactor, traffic would be less but the impact would still be less preferable than at the Clinch River site.

If the PBNP units are built, an additional building on the site would add relatively little visual intrusion, and less than a reactor at Clinch River. However, because of the relatively small amount of work that has been completed at Phipps Bend, offsite visual intrusion, currently minimal, could be noticeable if one or both PBNP units are cancelled and an LMFBR is constructed. This situation is comparable to that at the Clinch River site with respect to visual intrusion.

The estimated potential construction labor force around Phipps Bend is 19,832 workers. Therefore, the demands on the regional labor force would be less favorable than at the Clinch River site where the labor force is estimated to be 22,905.

Overall, the staff judges the Phipps Bend site to be less desirable than the Clinch River site with respect to socioeconomic impacts of the LMFBR plant.

1.3.6 Population Density

Population totals and projections in the vicinity of the Phipps Bend site are as follows:

Distance from site (mi)	1980		1990		2030	
	Total population	Density (persons/mi ²)	Total population	Density (persons/mi ²)	Total population	Density (persons/mi ²)
0 - 5	5,737	73	6,648	85	15,315	195
0 - 10	23,297	74	30,245	96	125,296	399
0 - 20	174,342	139	216,975	173	659,864	525
0 - 30	373,617	132	468,690	166	1,455,201	515

Comparable data for the proposed CRBRP site are in Section 1.1.6.

Although the data indicate that the total population and population densities are lower at this alternative site than at Clinch River, both sites have population densities which are well below the threshold values of Regulatory Guide 4.7 and criterion VI.2.b(7) of the proposed rule on alternative sites, and, therefore, both sites are in areas of low population density.

The staff concludes that, despite actual differences in population density, the residual accident risks are not expected to be significantly different and would be very low at either site. Consequently, neither site is considered to be environmentally preferable compared to the other with regard to population density.

1.3.7 Industrial, Military, and Transportation Facilities

A small plastics manufacturing plant employing about 100 people is located approximately 1 mile north-northwest of the nearest safety-related structures. Several other plants are located between 2.7 and 4.3 miles from the Phipps Bend plant. Because of the quantities of material and distances involved, these industries will not adversely affect the safe operation of a nuclear plant.

There is no commercial barge traffic on the Holston River in the vicinity of the site.

Chlorine and acetaldehyde have been identified as toxic materials transported near the site that would require reactor control room protection.

The nearest railroad passes the site approximately 7500 ft from the nearest safety-related structure. Munitions are shipped on this railroad to or from the Holston Army Ammunition Plant, which is approximately 8 miles northeast of the site. This separation distance is adequate to preclude adverse effects on a nuclear plant because of accidental detonations.

A small county airport with a single 3500-ft runway is 4.2 miles west of the site. There are airways and training routes located from 1.2 miles to 7 miles from the site. Based on data on aviation activities near this site and on staff analysis of similar activities at other nuclear power plant sites, the staff concludes that the probability of an aircraft crashing into the Phipps Bend plant is within the acceptance criteria of Standard Review Plan Section 2.2.3 (NUREG-0800) and is acceptable.

A 6.25-in.-diameter natural gas pipeline passes about 7500 ft northwest of the site. Because of the size of the line and the distance involved, this pipeline does not represent a hazard to the safe operation of a nuclear plant.

The staff concluded that additional expenditures necessary to make the plant licensable at the Phipps Bend site with respect to the above hazards would not be significantly greater than at the Clinch River site.

1.4 Yellow Creek

The Yellow Creek site is located in northeast Mississippi, about 9 miles north of Iuka, Mississippi, and 30 miles west-northwest of Florence, Alabama. Two 1285 MWe nuclear units are partially constructed on the 1160-acre site. The coordinates are 34°57'24" latitude, 88°12'57" longitude.

1.4.1 Geology and Seismology

The Yellow Creek site is on the boundary between the Central Stable Region Tectonic Province and the Gulf Coastal Plain Province. Structurally the site is on the east flank of the Mississippi Embayment and the west flank of the Nashville Dome. The New Madrid faulted belt is about 80 miles west of the site. The SSE is based on the postulated occurrence of an MMI VII-VIII in the vicinity of the site and an MMI XI-XII 80 miles from the site.

The site is on a dissected plateau with an average elevation of 600 ft msl. Plant structures will be founded on the Ft. Payne formation, a calcareous siltstone that does not typically support the development of cavernous or karst conditions. Bedrock is overlain by several tens of feet of residual soil, alluvial sands of the Cretaceous Eutaw formation, and sand and gravel terrace deposits.

The Yellow Creek site is considered to be equivalent to the Clinch River site for the proposed LMFBFR because seismic design requirements are similar at the two sites, and the foundation rock at both sites is of high quality. The staff concluded that licensing costs with respect to these parameters would be comparable to those at the Clinch River site.

1.4.2 Hydrology

The Yellow Creek site is on the east bank of the Yellow Creek embayment of Pickwick Lake, which is on the Tennessee River. The average annual flow in the Tennessee River at this location is 56,000 cfs. Thus, this site is more favorable than the Clinch River site with respect to water availability. However, because of the small amount of water needed for the proposed LMFBFR, water availability is a relatively insignificant issue.

The nearest drinking water intake is about 10 miles downstream. There are approximately 20,000 people (1970 census) downstream within 50 miles of the site and adjacent to the Tennessee River. The ratio of people potentially served to river flow rate is therefore $20,000/56,000$, or about 0.35 person/cfs, which is lower than the 7.7 people/cfs for the Clinch River site. Yellow Creek is therefore preferable on the basis of population served and dilution of liquid effluents.

Minimum plant grade is about 500 ft msl, which is about 86 ft above normal full pool on Pickwick Lake. Therefore, flooding or encroachment onto the flood plain should be minimal at this site, making it comparable to the Clinch River site in this regard.

The site is on unconsolidated materials of low permeability. Transport of radioactivity through groundwater would be relatively less at this site than at the Murphy Hill, Hartsville, or CRBRP site.

Overall, the Yellow Creek site is more favorable than the CRBRP site in regard to hydrology. However, costs relative to hydrology aspects of licensing are judged to be comparable.

1.4.2.1 Water Quality

Makeup water for the closed-cycle Yellow Creek Nuclear Plant will be drawn from Yellow Creek and station discharges will be returned directly to the Tennessee River.

Near the site the Tennessee River is of moderate hardness and relatively low in dissolved minerals. Mineral quality would be considered slightly better than that of the Clinch River. The waters of Yellow Creek would be considered very soft, but Yellow Creek tends to be higher in dissolved organics than the Tennessee River. Both water bodies are of good quality from the sanitary engineering standpoint, demonstrating that they are relatively free of stresses from municipal waste discharges. Pickwick Lake does stratify thermally in summer months and at such times the dissolved oxygen concentration decreases markedly with depth. During the dry season, which is the period of interest for assessing impact to water quality, the flow from Yellow Creek decreases to a very low rate, at times reaching zero. Thus, at such times, the makeup would essentially be Tennessee River water.

Surface temperature of the Tennessee River at times naturally exceeds the State of Mississippi maximum temperature standard. Therefore, it is necessary that alternative temperature limitations be established as prescribed in Section 316(a) of the Clean Water Act.

Because of the large flow in the Tennessee River and because of the small addition of chemicals at the Yellow Creek plant, the FES (NUREG-0365) concluded that chemical discharges would be within applicable water quality standards and, in fact, that water quality in Pickwick Lake would not be changed measurably by the two 1285 MWe units, and the addition of the 350 MWe breeder unit would not alter this conclusion.

Because attainment of state water quality standards resulted in no special mitigative requirements at Yellow Creek, this site is slightly better than the proposed Clinch River site relative to impact on water quality.

1.4.3 Meteorology

The meteorological considerations for Yellow Creek are similar to those for the sites discussed above and the Clinch River site (see Section 1.1.3 above).

1.4.4 Ecology

1.4.4.1 Aquatic Ecology

An LMFBR would withdraw water from the Yellow Creek embayment and discharge into Pickwick Lake for the closed-cycle cooling system.

Based on information provided to the NRC during the Yellow Creek Nuclear Plant Units 1 and 2 construction permit review, the Yellow Creek embayment of the lake is important to the maintenance of the reservoir fishery (NRC, 1977). The embayment and Pickwick Lake proper are dominated (in terms of relative abundance) by gizzard shad, threadfin shad, bass, and sunfish. The embayment serves as an important nursery area of the reservoir, and it supports a significant commercial fishery for blue catfish, channel catfish, flathead catfish, smallmouth buffalo, and carp (ER, App F-7). The embayment also supports a significant sports fishery for bass, sunfish, white bass, and white crappie.

No aquatic species collected in the area are listed as threatened or endangered by the U.S. Fish and Wildlife Service. Cyceptus elongatus (blue sucker), collected from Pickwick Lake, is considered threatened by the State of Tennessee (TWRA, 1975).

The Yellow Creek site was evaluated from the standpoint of two siting situations: the LMFBR unit with the two light water reactor units completed and the LMFBR as the only operating unit on the site. The Yellow Creek site was compared to the Clinch River site with regard to impacts to aquatic biota associated with plant construction and operation.

If both of the Yellow Creek units are completed, an additional intake for an LMFBR would have to be built and the resulting impacts resulting from construction would be comparable to those at the Clinch River site; however, if one or both of the Yellow Creek units were cancelled, then an LMFBR could utilize the resulting excess intake capacity, thereby causing little or no impact to aquatic biota as a result of intake construction because little inriver construction relative to that required at the Clinch River site would be necessary. The Yellow Creek site would then be environmentally preferable with respect to intake construction.

The discharge pipeline has not been constructed for the Yellow Creek plant and it is presumed that it could be sized slightly larger to accommodate the additional LMFBR blowdown flow. With respect to the impact on aquatic organisms of construction of the discharge pipeline, the two sites are environmentally comparable. The Yellow Creek site already has a barge-unloading facility, site

preparation has been completed for the Yellow Creek units, and site runoff-holding facilities are functional. Aquatic impacts associated with construction of the barge-unloading facility and additional site preparation for the breeder would be minimal at the Yellow Creek site. Therefore, with respect to these construction activities, the Yellow Creek site is environmentally preferable to the Clinch River site.

On balance, construction impacts at the Yellow Creek site would be environmentally preferable to those at the Clinch River site if both Yellow Creek units are completed, as well as if one or both of the Yellow Creek units are cancelled. However, construction-related impacts are temporary, largely mitigable, and can be scheduled to further minimize effects. The applicants will be required to implement an approved erosion-control plan prior to construction. Although preferability of one site over another can be established for construction-related impacts, the staff finds, based on the above, that the importance of this preferability in the evaluation of alternatives is minor.

The impacts on aquatic biota of plant operation at the Yellow Creek site as a result of impingement, entrainment, and the thermal plume were analyzed for both siting situations. Use of the existing or a new perforated pipe intake at the Yellow Creek site would result in negligible impingement and entrainment losses comparable to those expected at the CRBRP site.

For either siting situation the use of the Yellow Creek discharge pipeline would have an inconsequential impact on aquatic biota inhabiting Pickwick Lake, whereas the thermal discharge from the CRBRP at the Clinch River site has the potential, under low- or no-flow conditions, to impact striped bass that utilize that stretch of river as a thermal refuge during the late summer and early fall (see Sections 2.7.2 and 5.3.2.2). Should studies conducted by the applicants prior to plant operation fail to conclusively demonstrate that impact to striped bass will not occur, the applicants have committed (Longenecker, 1982) to restricting the thermal discharge from the CRBRP during periods when the river water temperature is high and zero flow conditions exist. Furthermore, EPA in the draft NPDES permit (III.M, see Appendix H) will require that no thermal impact to striped bass occur because of plant operation. Thus, the Yellow Creek site is judged environmentally comparable to the Clinch River site with respect to the potential for impact on aquatic biota as a result of the thermal discharge.

Overall, the staff concludes that siting the LMFBR demonstration plant at the Yellow Creek site configurations would be environmentally comparable to the Clinch River site with respect to the impact of construction and operation on the aquatic biota inhabiting the source and receiving water bodies.

1.4.4.2 Terrestrial Resources

No Federal lands or natural landmarks are on or near the site. There are no state or local parks on the site. However, two large state parks (J. P. Coleman State Recreational Area and Tishomingo State Park) are located within the area (Tishomingo County).

While there are no privately dedicated areas on the site, recreational areas oriented toward water activities are numerous in the area.

There are no critical habitat areas on or near the site.

Before the start of construction activities related to Yellow Creek Units 1 and 2, the site was predominantly forested. Only 5% of the 1160 acres had been cleared for pasture or other agricultural uses. As a result of construction activities, the staff estimates that approximately 30% of the site has been cleared or otherwise affected.

No Federally listed rare or endangered species are found on the site. Prior to construction activities, there was a rather high diversity of animals on site. This diversity still exists in the region (NUREG-0365), but construction activities have reduced both animal populations and diversity. There are no rare or endangered species on the site.

There are no agriculture activities on the site, and the staff estimates that the site contains little or no prime or unique farmland.

Two small areas of wetlands have been impacted by construction activities. Further impact by siting another facility at this site could occur, but inexpensive compensating measures can be adopted.

Assuming that the demonstration plant is placed on an undisturbed portion of the Yellow Creek site, the site would offer no substantial advantage over the Clinch River site in terms of impacts on terrestrial resources. This judgment recognizes that the staff has already found that the terrestrial resources on the Clinch River site are not unique and that impacts on them from construction and operation of the CRBRP would be small. However, if one or more of the partially constructed units are cancelled and some cleared portion of the site becomes available, the Yellow Creek site would be preferable in terms of impacts to terrestrial resources.

1.4.5 Socioeconomics

There are no historic structures located on the Yellow Creek site, although an historic cemetery is located in the immediate vicinity (NUREG-0365). TVA conducted an intensive archeological survey and found numerous archeological sites (ibid). Scenic and recreational enjoyment of the area have already been disrupted by construction at the site (ibid).

Placement of a breeder reactor on the site of the proposed Yellow Creek units would likely disrupt numerous archeological sites. This situation would be less preferable than at the Clinch River site.

Seven households were relocated when construction began at Yellow Creek, and no economic activities required relocation. It is doubtful that further displacement would be required if the LMFBR were relocated to Yellow Creek. This situation would be comparable to Clinch River because no displacement is necessary at the proposed site.

Before Yellow Creek Nuclear Plant construction began, serious doubts existed about the ability of area roadways to handle construction traffic (ibid). State Routes 25 and 365, U.S. 73, Short Road, and Old Iuka-Red Sulphur Springs Road were expected to be heavily impacted. Because of the apparently inherent

deficiencies in local road systems, traffic congestion would be more of a problem at Yellow Creek than at the Clinch River site.

Because a good portion of the commercial station at Yellow Creek has been constructed (about one-third), the visual intrusion from adding a breeder reactor there would be less than at the Clinch River site.

The area within commuting distance of the Yellow Creek site is estimated to contain a construction labor force of 10,177 by 1985. By this criterion, Yellow Creek is less desirable than the CRBRP site, which would have a work force of 22,905.

Overall, the staff considers the Yellow Creek site to be less desirable than Clinch River in terms of socioeconomic impacts.

1.4.6 Population Density

Population totals and projections in the vicinity of the Yellow Creek site are as follows:

Distance from site (mi)	1980		1990		2030	
	Total population	Density (persons/mi ²)	Total population	Density (persons/mi ²)	Total population	Density (persons/mi ²)
0 - 5	1,040	13	1,140	14	1,354	17
0 - 10	6,180	22	7,615	24	9,487	30
0 - 20	59,115	47	69,080	55	99,253	79
0 - 30	116,815	41	135,206	48	195,073	69

Comparable data for the proposed CRBRP site are in Section 1.1.6.

Although the data indicate that the total population and population densities are lower at this alternative site than at Clinch River, both sites have population densities which are well below the threshold values of Regulatory Guide 4.7 and criterion VI.2.b(7) of the proposed rule on alternative sites, and, therefore, both sites are in areas of low population density.

The staff concludes that, despite actual differences in population density, the residual accident risks are not expected to be significantly different and would be very low at either site. Consequently, neither site is considered to be environmentally preferable compared to the other with regard to population density.

1.4.7 Industrial, Military, and Transportation Facilities

An oil storage facility is located at the Yellow Creek port, approximately 1.8 miles north and west of the Yellow Creek site. This distance is sufficient to preclude adverse effects, except for smoke effects resulting from fires, which may require control room protection.

The closest major land transportation route is State Highway 25, about 2 miles west of the site. The closest airport is at Iuka 13 miles south of the site.

The plant site is near two Federal airways and a military jet training area. Based on staff analysis of these routes, the staff concludes that the probability of an aircraft crash is acceptably low (less than about 10^{-7} per year) and need not be considered in the plant design basis.

The closest natural gas pipeline is a 6-in. line located 7.5 miles northwest of the site. The closest railroad is 7 miles to the northwest, with a spur extending to the Yellow Creek port 1.8 miles northwest. These separation distances are adequate to ensure no adverse impacts on a nuclear plant.

The main channel of the Tennessee River is 2 miles east of the site and is a major barge route. Presently, the Yellow Creek embayment is not available to commercial barge traffic. However, upon completion of the Tennessee-Tombigbee Waterway, an estimated 24,000,000 tons of materials will be shipped past the site annually. Appropriate design and/or location of the plant intake structure would ensure against damage to the intake structure from barge collisions and fires. The plant itself should not be affected by such hazards.

The staff concluded that the additional costs of licensing at Yellow Creek for protection of the plant from nearby hazards are not likely to be significantly greater than at the Clinch River site.

2 DOE SITES

2.1 Hanford

The Hanford site is located in the southeast area of DOE's large Hanford reservation, about 9 miles northwest of North Richland, Washington, 1.5 miles north-northwest of the Fast Flux Test Facility (FFTF), and 5 miles southwest of the Washington Public Power Supply Systems' WNP-2 facility. The coordinates are 46°26'00" latitude, 119°23'00" longitude.

2.1.1 Geology and Seismology

The Hanford reservation is in the Pasco Basin, a structural downwarp within the Columbia River Basalt Plateau of eastern Washington and Oregon and southern Idaho. The Pasco Basin is bounded by long sinuous folds in the basalt bedrock that trend in generally east-west to northwest-southeast directions. These folds reach a maximum elevation of more than 3500 ft msl on top of Rattlesnake Mountain southwest of the site. The site surface elevation is about 450 ft msl. The Hanford area is underlain by at least 5000 ft of basalt flows ranging in age from Miocene to Pliocene. Overlying basalt in the site area are several hundred feet of dense Pliocene-Pleistocene soils of the Ringfold formation, which is overlain by glaciofluvial sands and gravels.

The area is characterized by the infrequent occurrence of low- to moderate-intensity earthquakes, the sources of which are not known. There are indications in the geologic record within the region of relatively recent tectonic

activity. The appropriate earthquake design basis for this region has not been established, although much work is being done by the Washington Public Power Supply System, Puget Power, and DOE to accomplish that goal. Other facilities in the region are designed for vibratory ground motion values of 0.25g at WNP-1, 2, and 4 and at FFTF, and 0.35g at the Skagit-Hanford site, based on pre-Regulatory Guide 1.60 spectra.

The staff believes a Hanford site is licensable, but because of the current uncertainty of the tectonic regime at Hanford, this site is considered to be less desirable than the Clinch River site in regard to geological and seismological considerations and additional costs associated with these considerations are likely to be required for licensing the plant at Hanford.

2.1.2 Hydrology

The Hanford reservation is adjacent to the Columbia River, which has an average annual flow near the site of about 120,000 cfs. This is more favorable than at the Clinch River site. However, because of the small amount of water required for the proposed LMFBR, water availability is not considered a significant item.

Population (1970) adjacent to the Columbia River downstream and within 50 miles of the site is estimated to be about 70,000. The ratio R of people potentially served to river flow rate is therefore $70,000/12,000$ or 0.58 people/cfs. Because this ratio is about 7.7 people/cfs at the Clinch River site, Hanford is preferable on the basis of effluent dilution and population served.

The PMF at the site is estimated to be 424.5 ft msl. Flood analyses for three other commercial nuclear plants at this site have shown that flooding will not be a problem. Floodplain encroachment will not occur. In these parameters, Hanford is equal to the proposed CRBRP site.

Groundwater is present under the site in unconsolidated glaciofluvial deposits. There are extensive data on the movement of groundwater and dissolved radioactivity at the Hanford site. The potential for contamination of water supplies from accidental releases of radioactivity at the site will be small and is considered to be equal to the Clinch River site.

Overall, in regard to hydrology, the Hanford site is more favorable than the Clinch River site. However, costs with respect to water availability and flood protection at the two sites would be comparable.

2.1.2.1 Water Quality

The Columbia River at the Hanford site has an average annual flow of 120,000 cfs, with a controlled minimum day flow average of 36,000 cfs. The quality of the Columbia River in that vicinity is excellent although state temperature standards are exceeded during late summer as a result of natural conditions. The concentrations of certain trace metals (cadmium, copper, iron, lead, and mercury) at times exceed EPA water quality criteria. Dilution of effluent streams with the flow in the Columbia River would virtually ensure that any LMFBR discharges would not be measurable. Even at the controlled minimum low flow, the river would dilute the breeder project waste stream by a factor of 7200.

The slightly better water quality in the Columbia relative to the Clinch and the substantially higher dilution flow in the Columbia would appear to give the Columbia an environmental advantage. However, because the Clinch River site can accommodate the breeder project with no significant adverse water quality impact on other uses, the apparent advantage does not weigh heavily in selecting among the alternatives.

2.1.3 Meteorology

The Hanford site is a desert-type site with diffusion characteristics that are different from nondesert sites. Based upon extensive diffusion studies, it has been found that, although there is high joint frequency of stable and low wind speeds, considerably better diffusion characteristics exist in desert regions than in nondesert regions. From a diffusion point of view, the far west sites (Hanford and INEL) have better diffusion conditions than the TVA sites. This would lead to less conservative χ/Q values being utilized for evaluation of the impacts of routine and accidental releases than are utilized for the other sites.

This site is in Tornado Region III, which would require a design to withstand the effects of a maximum wind speed of 240 mph.

The staff concludes that the Hanford site is preferable to the proposed site with regard to meteorological considerations, and somewhat lower costs for licensing would be required compared to the Clinch River site.

2.1.4 Ecology

2.1.4.1 Aquatic Ecology

The LMFBR at the Hanford site would withdraw and discharge water to the Columbia River for the closed-cycle cooling system.

A number of studies on aquatic biota have been conducted in the vicinity of the proposed site in support of the Washington Public Power Supply System Nuclear Plants 1, 2, and 4 and the Puget Sound Power and Light Company's proposed Skagit/Hanford Nuclear Plant (WPPSS; PSPLCo, 1981). The most abundant resident species of fish collected from the river near the proposed site are the large-scale sucker, bridge-lip sucker, squawfish, chiselmouth, and the red-side shiner. Important anadromous fish from the site are the chinook, coho, sockeye salmon, steelhead trout, and American shad (PSPLCo, 1981). Spawning of the fall run of chinook salmon and steelhead trout occurs in the Columbia adjacent to Hanford reservation. Shad may also spawn in the Hanford section of the river (WPPSS). No Federally recognized threatened or endangered aquatic species is known to occur in the Columbia River in the vicinity of this site.

The Hanford site was evaluated for aquatic impacts resulting from the construction and operation of the LMFBR on a site near the FFTF with an intake and discharge located to the east in the Columbia River. For this comparison, intake and discharge structures of the same designs as those proposed for the Clinch River site were evaluated for the Hanford site. Impacts associated with the construction of the intake and discharge structures at the two sites were judged to be equivalent.

Because of the size of the Columbia River, the inland location of the site, the porosity of the soil, and the more arid conditions at the Hanford site, the potential for site runoff having a detrimental effect on aquatic biota is significantly less than at the Clinch River site.

Overall, the staff finds that the Hanford site is environmentally preferable with respect to LMFBFR construction-related impacts on aquatic biota. However, construction-related impacts are temporary, largely mitigable, and can be scheduled to further minimize effects. The applicants will be required to implement an approved erosion control plan prior to construction. Although preferability of one site over another can be established for construction-related impacts, the staff finds, based on the above, that the importance of this preferability in the evaluation of alternatives is minor.

The impacts of plant operation on aquatic biota at the Hanford site as a result of impingement, entrainment, and the thermal plume were compared to those projected for the Clinch River site.

The use of intake proposed for the Clinch River at the Hanford reservation would result in negligible impingement and entrainment losses, comparable to those predicted for the Clinch River site.

The blowdown discharge represents about 0.008% of the lowest mean monthly flow. Thus the additional thermal loading from an LMFBFR at the Hanford site would not result in an adverse impact to aquatic biota inhabiting the Columbia River, whereas the thermal discharge of a plant at the Clinch River site has the potential, under low- or no-flow conditions in the Clinch River, to impact striped bass that utilize that stretch of river as a thermal refuge during the late summer and early fall (see Sections 2.7.2 and 5.3.2.2). Should studies conducted by the applicants prior to plant operation fail to conclusively demonstrate that impact to striped bass will not occur, the applicants have committed (Longenecker, 1982) to the restricting the thermal discharge from the CRBRP during periods when the river water temperature is high and zero flow conditions exist. Furthermore, EPA in the draft NPDES Permit (III.M; see Appendix H) will require that no thermal impact to striped bass occur because of plant operation. Thus, the Hanford site is judged to be environmentally comparable to the Clinch River site with respect to the potential for impact on aquatic biota as a result of thermal discharge.

The staff concludes overall that an LMFBFR at the Hanford site is environmentally comparable to an LMFBFR at the Clinch River site with respect to the impact of construction and operation on the aquatic biota inhabiting the source and receiving water bodies.

2.1.4.2 Terrestrial Resources

The Hanford reservation occupies about 360,000 acres of the southeastern part of the State of Washington. The Hanford site, owned by DOE, is primarily dedicated to nuclear activities, including research into advanced reactor designs as well as the commercial operation of nuclear power (NUREG-75/012).

There are no natural landmarks on the site; however, there are two registered sites within 50 miles--Ginkgo Petrified Forest and Grand Coulee. There are no

state or local parks on the site; Olmstead Place State Park is approximately 50 miles from the site. No privately dedicated areas are on or near the site.

The Arid Lands Ecology (ALE) Reserve occupies about 120 mi² of the site. Additionally, 86,000 acres of the site are being reserved for a wildlife refuge and recreation area by the Washington State Department of Game. These areas would not be affected by construction activities. The ALE Reserve also contains several endangered plant species.

The site contains eight major kinds of shrub-steppe plant communities. The most broadly distributed vegetation type is the sagebrush/cheatgrass or sagebrush/Sanberg's bluegrass association.

Mule deer, cottontail rabbit, jackrabbit, porcupine, and a variety of small mammals are on the site. Waterfowl, especially the Canada goose and mallards, occupy the Hanford Reach of the Columbia River during peak migratory periods.

Federally listed endangered species that may use the site for a refuge are the American peregrine falcon and the bald eagle.

There are no farmlands on the site. A small portion of the site is classified as "prime farmland soil, if irrigated."

A riparian community occupies the banks of the Columbia River.

Hanford is an extremely large site with terrestrial resources characteristic of large regions in the western states. The parts of the site preserved for environmental research and wildlife would not have to be impacted by any siting activities connected with an LMFBR. Although the terrestrial resources of the Clinch River and the Hanford sites are characteristic of entirely different ecosystems (such as forested vs. rangeland), the staff cannot determine any significant reason for preferring one site or the other in terms of mitigating or impacting terrestrial resources primarily because both sites would require some clearing activities.

2.1.5 Socioeconomics

There are no scenic, historic, or recreational sites on the Hanford reservation (PMC, 1977). However, the Hanford Dunes and Arid Lands Ecology Reserve have been proposed as National Natural Landmarks. The Hanford Reach of the Columbia River has been proposed as a potential wild, scenic, or recreational river under the Wild and Scenic Rivers Act. None of these should affect the Hanford reservation as a candidate site (PMC, 1982).

Many significant archeological sites have been discovered in the Hanford area, especially along the Columbia River (PMC, 1977). Several recorded Wanapam Indian villages and campsites were located there (PMC, 1982). One archeological site is known to be located on the site, but this will not be disturbed by existing construction (PSPL, 1982).

The Hanford site is comparable to Clinch River with respect to the potential for displacing or disrupting onsite resources.

The Hanford reservation has been government property since 1943, and, thus contains no residential or economic activities. The sites are comparable with respect to displacement of such activities, because none would occur at the Clinch River Site.

Route 10, Route 4 South, and State Highway 240 would be the routes used most by construction traffic. Large construction projects have occurred on the Hanford site, and the tri-cities area road system has proven capable of handling the traffic (PSPL, 1982). Traffic near the Hanford site would increase because of additional workers, and the resulting congestion would be comparable to that at the Clinch River site.

With two nuclear reactors currently being built at Hanford, the construction of a breeder reactor would add little visual intrusion as compared to a single plant on the undeveloped Clinch River site. Therefore, the Hanford site is preferable with respect to visual intrusion.

The staff estimates that a construction labor force of 6244 will reside near the plant in 1985. In this regard, the Hanford site is less desirable than the Clinch River site, which has an estimated labor pool of 22,905.

Overall, the staff concludes that the Hanford site is less desirable than Clinch River with respect to socioeconomic impacts.

2.1.6 Population Density

Population totals and estimates for the Hanford site are as follows:

Distance from site (mi)	1980		1990		2030	
	Total popu- lation	Density (persons/ mi ²)	Total popu- lation	Density (persons/ mi ²)	Total popu- lation	Density (persons/ mi ²)
0 - 5	0	0	0	0	0	0
0 - 10	13,924	44	19,432	62	37,154	118
0 - 20	87,283	69	121,807	97	232,894	185
0 - 30	133,379	47	186,135	66	355,890	126

Comparable data for the proposed CRBRP site are given in Section 1.1.6.

Although the data indicate that the total population and population densities are lower at this alternative site than at Clinch River, both sites have population densities which are well below the threshold values of Regulatory Guide 4.7 and criterion VI.2.b(7) of the proposed rule on alternative sites, and, therefore, both sites are in areas of low population density.

The staff concludes that, despite actual differences in population density, the residual accident risks are not expected to be significantly different and would be very low at either site. Consequently, neither site is considered to

be environmentally preferable compared to the other with regard to population density.

2.1.7 Industrial, Military, and Transportation Facilities

The Hanford reservation consists of about 360,000 acres controlled by DOE. Land uses consist of a number of DOE nuclear production reactors and various laboratory facilities plus the Fast Flux Test Facility (FFTF). Private leases of land include the WPPSS plant at the 100-N area and leases for WPPSS Units 1 and 2 under construction.

Other than the above facilities and the onsite road and railroad system, there are no industrial or military facilities nearby of concern to a nuclear plant.

The proposed LMFBR alternative site is approximately 5 miles southwest of the WPPSS 1, 2, and 4 site and 5 miles south of the Skagit/Hanford site. The site is approximately 1.5 miles northwest of the FFTF reactor. There are no oil or gas pipelines in the vicinity of the site. The major gas pipeline is more than 15 miles from the site. There are no airports within 10 miles of the site. The closest airport is Richland Airport approximately 12 miles south-southwest.

The NOAA aeronautical chart indicates a notice that aircraft are requested to avoid the area (Hanford reservation) below 2400 ft msl for national security reasons.

The staff concludes that licensing costs with respect to protection of the plant from the above hazards would be comparable to those at the Clinch River site.

2.2 Idaho National Engineering Laboratory (INEL)

The site is on the large INEL reservation about 23 miles west-northwest of Idaho Falls, Idaho and about 7 miles east-northeast of the EBR-II plant. The approximate coordinates are 43°40'00" latitude, 112°30'00" longitude.

2.2.1 Geology and Seismology

INEL is on the eastern section of the Snake River Plain, which is a subdivision of the Columbia Plateau Province. The Snake River Plain is underlain by a thick sequence of Tertiary and Quaternary lava flows and associated interbeds of alluvial, lacustrine, and eolian deposits. The plain is rough surfaced but generally flat. Northwest and southeast of the plain are north-south trending, generally parallel mountain ranges, composed of folded and faulted Paleozoic rocks. These ranges and intervening valleys were formed by block faulting (horst and graben), which is typical of basin and range terrain. Capable faults (the Arco and Howe faults) have been mapped on the west flank of two of the north-south mountain ranges north of INEL. There is no evidence that the faults cut the Tertiary-Quaternary basalts of the Snake River Plain, but alignments of volcanic vents and rhyolitic domes, forming prominent buttes, extend across the plain along projections of the faults. These alignments are parallel to a young (2000-year old) rift zone extending southeast from the Craters of the Moon area.

The INEL area has been relatively aseismic historically, but the basin and range terrain to the north, south, and southeast are very active. The basalt bedrock would make an adequate foundation for an LMFBFR. However, the INEL site is considered to be less suitable than the CRBRP site for an LMFBFR demonstration plant because of the uncertainties about the tectonic regime and potential for earthquake occurrence at INEL. The applicants' estimate of 0.32g for the Loss-of-Fluid Test (LOFT) facility, in the northwestern part of the reservation (FES Table 9.5), indicates that a somewhat higher cost design may be necessary at INEL than at Clinch River, where the plant is designed for 0.25g. However, the applicants also indicate that the earthquake acceleration value at EBR II is 0.22g, and they have reduced the costs of items 10, 11, and 12 shown in Table A9.4 (Chapter 9) for changing the site to INEL. Nevertheless, the staff believes that considerable effort would be required to validate the earthquake design bases at a specific site in the region.

2.2.2 Hydrology

The INEL site is located on a major aquifer, the Snake River Plain aquifer, which is a large regional water resource. Water for plant operation would come from wells. Blowdown water would be discharged to a pond approximately 10 acres in area, from which the effluent would evaporate and percolate into the ground. Water availability is not regarded as significant because of the small amount of water required for the LMFBFR demonstration plant.

Flooding may occur locally on the Big Lost River because of spring snow melt, but is of little concern to plant siting. No floodplain encroachment is expected. In regard to these parameters, the INEL site is considered equal to the CRBRP site.

The water table at the site is deep and fast moving. While the transport of radioactivity through the groundwater would not affect any current public water supplies, it might affect a future use of this resource. In this regard, the site is less desirable than the proposed CRBRP site.

Overall, the hydrology considerations of the Idaho site are less desirable than the Clinch River site, and costs to ensure water availability would be somewhat higher than at the Clinch River site.

2.2.2.1 Water Quality

If located at INEL, an LMFBFR would utilize groundwater and would ultimately return the waste streams to the groundwater. The groundwater reservoir beneath the INEL is extremely large relative to the breeder project water requirements. However, when waste streams are returned to this reservoir, they would not be diluted in the same way that wastes discharged to a surface water body would be diluted; rather, they would move with the groundwater flow, changing in quality by interaction with surrounding soil. At a distance from the site, a well that intercepts the path of the waste flow would draw water from a range of depths, which, in effect, would provide dilution at the point of use. Wastes could be returned to the groundwater in such a way that the likelihood of interference with other users would be minimum.

The behavior of waste streams introduced into groundwater is not entirely predictable and, therefore, such waste disposal is generally done intentionally only after some deliberation. The staff does not feel that this would be an insurmountable design problem at INEL, but it does present some uncertainty and a minor additional cost.

The CRBRP site has the advantage of disposal to a surface water source. However, this advantage is not considered to weigh heavily in the comparison of alternatives.

Overall, the INEL site would be less desirable than the Clinch River site with respect to water quality considerations.

2.2.3 Meteorology

The meteorological considerations for the INEL site are similar to those for the Hanford site (see Section 2.1.3 above). Therefore, from a diffusion point of view, this site has better diffusion conditions than the proposed CRBRP site. This would lead to less conservative χ/Q values being utilized for evaluation of the impacts of routine and accidental releases than are utilized for the Clinch River site.

This site also is in Tornado Region III, requiring a design to withstand the effects of a maximum wind speed of 240 mph.

The staff concludes that the INEL is preferable to the proposed site with regard to meteorological considerations, and somewhat lower costs for licensing would be required compared to the Clinch River site.

2.2.4 Ecology

2.2.4.1 Aquatic Impacts

An LMFBR at the INEL site would withdraw water from the Snake River Plain aquifer. Surface discharge to an evaporation basin is planned for the blowdown stream. Surface water at the INEL site consists of three intermittent streams that terminate in four playas in the north-central part of the reservation. No surface streams leave the reservation.

No impacts to aquatic biota as a result of construction or operation of an LMFBR at the INEL site are postulated. The staff thus concludes that the INEL site is environmentally preferable to the CRBRP site with respect to the potential for impacts to aquatic biota.

2.2.4.2 Terrestrial Resources and Land Use

The INEL consists of 572,000 acres of Federally owned rangeland set aside for the construction, testing, and operation of a wide variety of nuclear facilities. No natural landmarks are on or near the site, nor are there any state or local parks, privately dedicated areas, or critical habitat areas on or near the site.

The vegetation on the site consists primarily of sagebrush, lanceleaf rabbit brush, and a variety of grasses. The only trees are found along the Big Lost River.

The vegetation supports a variety of wildlife consisting of small mammals, birds, reptiles, and a few large mammals. Small animals include chipmunks, ground squirrels, mice, and jackrabbits. Pronghorn antelope, coyotes, and bobcats are seen at the site. The only endangered species occasionally frequenting the site are the bald eagle and peregrine falcon.

There are no active farm operations or wetlands on site, but man-made lagoons on the site do attract birds. Riparian habitat exists along the three streams that run through the site.

The INEL site is characteristic of the western arid regions and is, therefore, more similar to the Hanford site than to the Clinch River site in terms of terrestrial resources. Because of the extensive size of this site and the lack of any unique terrestrial features, including no specific areas dedicated to the preservation or research of terrestrial resources (Section 2.1.4.2), the staff believes that this site would be slightly preferable to the Hanford site, and potentially preferable to the preferred CRBRP site, in regard to impacts on terrestrial resources. This conclusion is based on the staff's opinion that the diversity or richness of the terrestrial resources at INEL is less than at the Clinch River site and, therefore, siting at INEL would be slightly preferable.

2.2.5 Socioeconomics

The Experimental Breeder Reactor I (EBR I) area at INEL is considered an historical site. Another historical site, potentially eligible for inclusion in the National Register of Historic Places, has been identified on the property, but will not be impacted by construction (PMC, 1982). No archeological resources or scenic or recreational areas are known to exist on the INEL site. Therefore, construction at the INEL site might result in somewhat less disruption of onsite resources than at the CRBRP site, which contains several archeological findings. Thus, the staff views the potential impacts on such resources at INEL as preferable to those at the Clinch River site.

The INEL site area, like the Clinch River site, is Federally owned, with no private residences allowed. As no (nonnuclear) economic activities exist at these sites, no residential or economic activities will be displaced. (The INEL site does contain several nuclear facilities, but these would not be affected by the construction of a breeder reactor.) Therefore, the INEL site is comparable to the proposed site in this regard.

The site area is served mainly by U.S. Routes 20 and 26 and Idaho State Highways 88 and 22 (Eastern Idaho, 1981). Traffic congestion could be expected on the U.S. highways as traffic moves to the site from the Pocatello/Blackfoot and Idaho Falls areas. This situation would be comparable to congestion at the Clinch River site.

The INEL site area is undeveloped, desert-type rangeland, with sparse population (ibid). However, several facilities are already on site, thus minimizing the additional visual intrusion of a breeder reactor. The INEL site is therefore preferable from the standpoint of visual intrusion.

The staff estimates a potential 3346 people in the local labor pool. This is less desirable than at the Clinch River site, which has an estimated labor pool of 22,905, because it implies significantly more labor inmovement and greater demands on community facilities and services than at the proposed site. Overall, the staff judges the INEL site to be less desirable than the Clinch River site with regard to socioeconomic impacts.

2.2.6 Population Density

Population totals and estimates for the INEL site area are as follows:

Distance from site (mi)	1980		1990		2030	
	Total popu- lation	Density (persons/ mi ²)	Total popu- lation	Density (persons/ mi ²)	Total popu- lation	Density (persons/ mi ²)
0 - 5	0	0	0	0	0	0
0 - 10	0	0	0	0	0	0
0 - 20	5,272	4	6,989	6	10,612	8
0 - 30	77,735	27	103,060	36	156,476	55

Comparable data for the proposed CRBRP site are in Section 1.1.6.

Although the data indicate that the total population and population densities are lower at this alternative site than at Clinch River, both sites have population densities which are well below the threshold values of Regulatory Guide 4.7 and criterion VI.2.b(7) of the proposed rule on alternative sites, and, therefore, both sites are in areas of low population density.

The staff concludes that, despite actual differences in population density, the residual accident risks are not expected to be significantly different and would be very low at either site. Consequently, neither site is considered to be environmentally preferable compared to the other with regard to population density.

2.2.7 Industrial, Military, and Transportation Facilities

Other than the existing INEL facilities and the onsite road and railroad system, there are no nearby industrial or military facilities near INEL of concern to a potential nuclear power plant.

Because of the large site area for INEL, a demonstration breeder reactor such as the CRBRP could be located at the INEL site at sufficient separation distances from other facilities to preclude adverse effects upon it.

The proposed site is about 7 miles east-northeast of the EBR II reactor.

The nearest major natural gas pipeline (24 in. or larger) passes through Pocatello, approximately 40 miles south of the proposed site. There are no major oil pipelines near the site. The nearest railroad passes through Idaho

Falls in a north-south direction about 30 miles east of the proposed CRBRP alternate site.

The nearest airport is at Idaho Falls, approximately 30 miles east-southeast of the proposed CRBRP alternate site. The NOAA aeronautical chart indicates a notice that aircraft are requested to avoid the area (INEL) below 7700 ft msl for national security reasons.

The staff concludes that licensing costs at the INEL site with respect to protection against hazards to the plant would be comparable to those at the Clinch River site.

2.3. Savannah River

The site is in the northeast quadrant of the large DOE Savannah River Plant (SRP) reservation in the southwestern part of South Carolina. It is about 25 miles southeast of Augusta, Georgia, and about 7 miles west-northwest of Barnwell, South Carolina. The approximate coordinates are 33°19'00" latitude, 81°32'00" longitude.

2.3.1 Geology and Seismology

The Savannah River site is in the Coastal Plain Tectonic Province, within 20 miles of the Fall Zone, the boundary between the Piedmont and Coastal Plain Provinces. The site is underlain by approximately 900 ft of unconsolidated to semiconsolidated Coastal Plain sediments over early Paleozoic crystalline bedrock. Surface elevations on the reservation range from more than 300 ft msl to less than 100 ft msl near the Savannah River to the west. Elevations in the proposed site area range between 250 and 300 ft msl.

The northwest border fault of the Dunbarton Triassic Basin lies within a few miles southeast of the site. This fault is overlain by undeformed Late Cretaceous soil that is the age equivalent of the Black Creek and Peedee Formations of South Carolina. Recent investigations by the U.S. Geological Survey (USGS) found evidence of two previously unidentified northeast-trending faults in the area. The northwesternmost fault, the Millet Fault, crosses the southern third of the SRP. The Millet Fault is interpreted by USGS investigators to be a high-angle reverse fault within the Dunbarton Basin. The Millet fault offsets the base of the Upper Cretaceous about 700 ft and Late Eocene about 20 ft. Evidence indicates that displacement on the Millet Fault has decreased through time, 9 to 3 ft per million years through Upper Cretaceous to 0.5 ft per million years in the Upper Eocene. Evidence available to date does not indicate that this fault is capable. USGS investigations are still underway.

The Savannah River site is considered to be licensable from a geological standpoint. However, because of recent concerns regarding the Charleston seismicity and the proximity of the Savannah River site to that activity, it is likely that considerable effort would have to be expended to validate the site at the proposed safe shutdown earthquake and operating basis earthquake design bases. For this reason, the Savannah River site is considered to be somewhat less suitable than the Clinch River site with regard to geological and seismological considerations, and the associated costs for licensing are likely to be higher at the Savannah River site.

2.3.2 Hydrology

The Savannah River site is adjacent to the Savannah River, which has an average flow of about 10,400 cfs. This is more favorable than at the CRBRP site; however, because of the small amount of water required for the plant, water availability is not a significant issue.

The PMF was projected for the nearby Alvin Vogtle Nuclear Plant to be about 168.2 ft msl. Establishment of an LMFBF above this flood level (as are the Vogtle plants) should be no problem. There would be no encroachment in the 100-year flood plain. In regard to these parameters, this site is equal to the Clinch River site.

The Savannah River site is in the coastal plain. Groundwater on site exists under water table conditions and flows toward the Savannah River. Transport of accidental radioactivity through the ground to the Savannah River would probably not be a problem.

The nearest public drinking water user is about 112 miles downstream, outside of the 50-mile zone used in the present comparison. Therefore, drinking water contamination is not considered to be a problem, and the site is considered to be more favorable than the proposed Clinch River site.

Overall, in regard to hydrology, the Savannah River site is more favorable than the Clinch River site. However, the licensability costs associated with water availability and flood protection would be comparable at the two sites.

2.3.2.1 Water Quality

The Savannah River upstream of the DOE facility is highly regulated for hydroelectric power generation. The guaranteed minimum daily flow past the site is 5800 cfs. The river is quite low in dissolved mineral content. It has been subjected to significant municipal and industrial waste loadings (DOE, 1982), Environmental Control has designated it as a Class B waterway, suitable for domestic water supply usage.

Construction and operation of four 1100 MWe generating units at the Alvin W. Vogtle Nuclear Plant across the river were predicted to have no significant impact on water quality of the Savannah River and no impact on downstream users or aquatic biota (AEC, 1974). Construction and operation of the 350 MWe breeder unit also would have no significant effect on water quality.

In comparison to the Clinch River, the Savannah River is of slightly better quality in terms of content of dissolved inorganics and provides a higher minimum flow to dilute discharges. However, because water quality changes were concluded to have negligible impact at the Clinch River site, these differences should not weigh heavily in the comparison of alternatives.

2.3.3 Meteorology

The Savannah River site tends to have relatively poorer diffusion conditions than in other parts of the country, but it has somewhat better conditions than those expected in the TVA area. Based on meteorological data collected near

the Savannah River site, there is a relatively lower frequency of the joint occurrence of stable and low wind speed conditions. This results in relatively better χ/Q values than at the TVA sites for utilization in estimating the consequences of routine and accidental releases.

The Savannah River area is in Tornado Region I, which would require a design to withstand the effects of maximum tornado winds of 360 mph. In this regard it is comparable to the CRBRP site.

The staff concludes overall that meteorological conditions are slightly better at the Savannah River site than at the Clinch River site, and slightly lower costs for licensing the plant would probably be required than at the Clinch River site.

2.3.4 Ecology

2.3.4.1 Aquatic Ecology

An LMFBR at the Savannah River site would withdraw and discharge water from the Savannah River for the closed-cycle cooling system.

The biological characteristics of the Savannah River and some of its tributaries that drain the site are contained in a series of reports issued by the Philadelphia Academy of Natural Sciences (ANSP, 1970, 1978), in an FES issued for a defense waste processing facility that is proposed for the site (DOE, 1982), and in the Vogtle Nuclear Plant FES (AEC, 1974). The aquatic biological communities of the Savannah River near the site are generally typical of those of coastal southeastern rivers. Dredging the main channel up to Augusta, Georgia, during the 1950s and completion of upstream reservoirs have affected the biological communities by reducing shallow habitat and transport of sediment and allochthonous material (DOE, 1982). The Savannah River and its associated swamp and tributaries in the vicinity of the site have a very diverse fish fauna.

Studies conducted in support of the Vogtle plant construction permit application found that the most common forage and predaceous species of fish taken from the Savannah River in the vicinity of the Savannah River site were gizzard shad and longnose gar (AEC, 1974).

The results of an egg and larval fish study conducted in 1977 found that, in the vicinity of the Savannah River plant, the most abundant larvae were blueback herring. Some Dorosoma sp. and American shad larvae were also collected. More than 90% of all fish eggs collected were American shad.

The most important game species are the largemouth bass, smallmouth bass, pickerel, crappie, sunfish, and catfish. Important commercial species taken from the river are American shad, hickory shad, and striped bass.

One semiaquatic species, the American alligator, is known from the site and is on the Federal list of endangered species. This species is known from one onsite pond, two onsite creeks, and the swamp bordering the Savannah River. The shortnose sturgeon, also Federally recognized, has been reported from the

lower Savannah River (Dadswell). These species are not likely to be affected significantly by construction and operation of the breeder plant.

In addition to the two listed above, no aquatic species are listed by the State of South Carolina as endangered (State of South Carolina Code of Regulations 550-15) and none are known from the Savannah River project vicinity.

The Savannah River site was evaluated for aquatic impacts as a result of the construction and operation of an LMFBF sited in the northeast portion of the reservation. Makeup and blowdown water would be obtained from the Savannah River via a pipeline traversing the reservation in an east-west direction. For this evaluation, the LMFBF intake structure was considered to be of a design similar to that of the existing Savannah River project intake and the discharge similar to that proposed for the Clinch River site.

Considering the undisturbed nature of this alternative site, the long intake and discharge pipeline, and the necessity of inriver construction for a new intake and discharge, the staff finds that neither the Savannah River nor the CRBRP site is environmentally preferable to the other with respect to construction impacts on aquatic biota.

The impacts on aquatic biota of plant operation at the Savannah River site as a result of impingement, entrainment, and the thermal plume were also compared to those projected for the Clinch River site.

A properly designed intake at the Savannah River site would result in negligible impingement and entrainment losses, comparable to those at the proposed site.

The blowdown discharge represents about 0.1% of the minimum daily Savannah River flow. Thus, the additional thermal loading from an LMFBF at the Savannah River site would not result in an adverse impact to aquatic biota inhabiting the Savannah River, whereas the thermal discharge of an LMFBF at the CRBRP site has the potential, under low- or no-flow conditions in the Clinch River, to impact striped bass that utilize that stretch of river as a thermal refuge during the late summer and early fall (see Sections 2.7.2 and 5.3.2.2). Should studies conducted by the applicants prior to plant operation fail to conclusively demonstrate that impact to striped bass will not occur, the applicants have committed (Longenecker, 1982) to the restricting thermal discharge from the CRBRP during periods when the river water temperature is high and zero flow conditions exist. Furthermore, EPA in the draft NPDES Permit (III.M; see Appendix H) will require that no thermal impact to striped bass occur because of plant operation. The Savannah River site is therefore judged environmentally comparable to the Clinch River site with respect to the potential for impact on aquatic biota because of the thermal discharge.

The staff concludes overall that an LMFBF plant located at the Savannah River plant site would be environmentally comparable to one at the proposed site with respect to the impact of construction and operation on the aquatic biota inhabiting the source and receiving water bodies.

2.3.4.2 Terrestrial Resources

The Savannah River site is an 800-km² (300-mi²) controlled area owned by the Federal government. There are no natural landmarks on or near the site, nor are there any state or local parks on site. The site has been designated as a National Environmental Research Park. As a result, extensive areas are protected to provide research opportunities into the environmental impacts of human activities. Aside from those areas, there is sufficient space for the LMFBF demonstration project.

The site is approximately 90% forested. Because the area is large and topographically variable, its floral and faunal diversity and abundance have high ecological value.

The site contains considerable wildlife diversity because of its range of diverse habitats and its protection from the public. Four species listed as endangered or threatened by the U.S. Fish and Wildlife Service have been identified as possibly occurring on the site: bald eagle, red-cockaded woodpecker, Kirtland's warbler, and the American alligator. Only the red-cockaded woodpecker could find highly specific and suitable habitat in the area considered for a site, and observations to date have not found evidence of this species.

No agricultural operations are permitted on the site. Before it was acquired by the U.S. government, the Savannah River site was approximately one-third cropland and pasture. Some of this land may be classifiable as "prime farmland."

The site contains extensive floodplain swamp areas bordering onsite creeks and rivers. These areas would most likely not be impacted by construction or operational activities because of the large size of the site.

Both the Savannah River and the Clinch River sites are forested and would require removal of forested habitat. Although the Savannah River site has a greater variety of resources than the Clinch River site, the proposed locations on these sites are similar in most respects. Therefore, the staff concludes that the Savannah River site offers no significant advantage over the Clinch River site in terms of reduction of impacts to terrestrial resources.

2.3.5 Socioeconomics

There are no significant historic sites, public scenic attractions, or recreational or cultural areas located on the Savannah River site. Some small, prehistoric campsites have been found, but none of importance (PMC, 1977). The site was surveyed from December 1978 to January 1979, and no archeological or historic artifacts were found (DOE, 1982). Although some resources have been found on this site, no important resources would be impacted by construction, thus making the Savannah River and Clinch River sites comparable in this respect.

The Savannah River site does not contain residential or economic activities that would be displaced; it is therefore comparable in this respect to the Clinch River site.

Many state and Federal highways serve the Savannah River area. These include Interstate Highways 20, 26, and 95; U.S. Highways 321, 78, 378, 1, 178, 601,

278, and 21; and State Highways 125, 19, and 64. Because of the multitude of nearby multilane roadways (DOE, 1982) and because of the numerous points of access to the site, traffic congestion at Savannah River is likely to be less than congestion at the Clinch River site, thus making Savannah River preferable in this regard.

Existing structures at the Savannah River site include five nuclear production reactors (three operating, two in standby), a small test reactor, two separation areas for processing irradiated materials, a heavy water extraction and recovery plant, a fuel and target fabrication facility containing two test reactors, the Savannah River Laboratory, and other buildings (PMC, 1977). The addition of a breeder reactor to a remote part of the area would indicate less visual intrusion than at the Clinch River site.

The estimated 1985 construction force around Savannah River is 11,645. Thus, the Clinch River site, with a labor pool of 22,905, is judged preferable in regard to the local labor supply.

Overall, the staff considers the Savannah River site to be comparable to the proposed site in terms of socioeconomic impacts.

2.3.6 Population Density

Population totals and estimates for the Savannah River area are as follows:

Distance from site (mi)	1980		1990		2030	
	Total popu- lation	Density (persons/ mi ²)	Total popu- lation	Density (persons/ mi ²)	Total popu- lation	Density (persons/ mi ²)
0 - 5	0	0	0	0	0	0
0 - 10	5,471	17	6,046	19	8,344	27
0 - 20	45,983	37	50,821	40	70,129	56
0 - 30	239,092	85	264,248	93	364,644	129

Comparable data for the proposed CRBRP site are in Section 1.1.6.

Although the data indicate that the total population and population densities are lower at this alternative site than at Clinch River, both sites have population densities which are well below the threshold values of Regulatory Guide 4.7 and criterion VI.2.b(7) of the proposed rule on alternative sites, and, therefore, both sites are in areas of low population density.

The staff concludes that, despite actual differences in population density, the residual accident risks are not expected to be significantly different and would be very low at either site. Consequently, neither site is considered to be environmentally preferable compared to the other with regard to population density.

2.3.7 Industrial, Military, and Transportation Facilities

The Savannah River reservation consists of about 192,000 acres about 15 miles southeast of Augusta, Georgia. The site contains a number of DOE nuclear production reactors, several separation areas, a heavy water plant, and several other research and administrative facilities.

The proposed site is approximately 3 miles northeast of the Savannah River 100-R area and 4 miles northwest of the Barnwell County industrial park.

Other than the existing DOE facilities and the onsite road and railroad system, there are no nearby industrial or military facilities of concern to a nuclear plant.

Because of the large site area associated with the Savannah River reservation, a demonstration breeder reactor such as the LMFBR could be located within the Savannah River reservation at sufficient separation distances from other facilities to preclude adverse effects upon it.

The nearest airport according to the Atlanta Sectional Aeronautical Chart published by NOAA is at Barnwell, approximately 11 miles southeast of the proposed alternate site for the LMFBR. This chart indicates that for national security reasons, aircraft are requested to avoid flight over an 8.5 nautical-mile radius of a specific location (the Savannah River site) below 1200 ft msl. This radius extends over the proposed CRBRP alternative site.

The nearest major gas pipeline (24 in. or larger) extends from Macon to Aiken, South Carolina. A smaller gas pipeline extends due east for approximately 25 miles and then in a southeasterly direction to Savannah. This line is about 20 miles due north of the proposed reactor site. There are no major oil lines within 20 miles of the site. The nearest railroad is the Seaboard Coastline, which passes through the Savannah River Plant site approximately 11.5 miles southwest of the proposed reactor site.

The staff concludes that licensing costs for protection of the plant from the above hazards would be comparable to those at the Clinch River site.

3 CONCLUSIONS

Based on the preceding assessments of the four TVA alternative sites and three DOE sites in the States of Washington, Idaho, and South Carolina, the staff has concluded that all of these alternatives are probably acceptable as nuclear power plant sites and none of them is environmentally preferable to or substantially better than the proposed site at Clinch River. This conclusion is indicated by the composite ratings in Table L.1. The staff's judgments concerning each of the environmental parameters are summarized in the same table.

Table L.2 provides a qualitative comparison to Clinch River of additional costs that potentially could be incurred to make the proposed plant licensable at the alternative sites from a safety point of view. The qualitative cost differences do not take into account the fact that the CRBRP design is so far along that substantial changes would be costly. However, from inspection of Table L.1,

it does not appear that taking this fact into account would result in different conclusions. The table does not include costs to mitigate unduly adverse environmental impacts because none have been found. The composite ratings of these costs are included in Table L.1 under parameter 6, and they have been considered in arriving at the overall composite ratings in Table L.1.

Table L.1 Comparison of environmental parameters of alternative sites to Clinch River site

Site	Parameters Considered*						Composite Rating
	1	2	3	4	5	6	
Clinch River**	small	small	small	small	low	base	small
Hartsville	0	0	0	-	0	0	0
Murphy Hill	0	0	0	-	0	0	0
Phipps Bend	-	0	0	-	0	0	-
Yellow Creek	+	0	0	-	0	0	0
Hanford	+	0	0	-	0	0	0
Idaho (INEL)	-	+	+	-	0	0	0
Savannah River	+	0	0	0	0	0	0

*Parameters considered:

- 1 - Water use and quality
- 2 - Aquatic resources
- 3 - Terrestrial resources
- 4 - Socioeconomics
- 5 - Population density: population density near all these sites is low (i.e., under 500/mi² in 1990 and under 1000/mi² in 2030, averaged over any radial distance out to 30 miles)
- 6 - Additional expenditures to make project licensable.

**Base-line impacts from FES update

Definition of "small": The impacts are expected to be such that only minor mitigative actions, if any, are necessary.

Relative Ratings:

- 0 = Comparable (approximately the same degree of impact)
- += Preferable (a lesser degree of impact)
- = Less desirable (a greater degree of impact)

Table L.2 Comparison of additional costs of licensing the CRBRP at alternative sites vs. the Clinch River site from safety standpoint

Site	Considerations*					Composite Rating
	1	2	3	4	5	
Hartsville	-	0	0	0	0	0
Murphy Hill	0	0	0	0	0	0
Phipps Bend	0	0	-	0	0	0
Yellow Creek	0	0	0	0	0	0
Hanford	-	-	0	+	0	0
Idaho (INEL)	-	-	-	+	0	0
Savannah River	-	-	0	+	0	0

*Considerations:

- 1 - Geology
- 2 - Seismology
- 3 - Hydrology
- 4 - Meteorology
- 5 - Nearby industrial, military and transportation facilities

Relative Ratings:

- 0 = Comparable
- + = Preferable
- = Less desirable

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APPENDIX M

LIST OF CONTRIBUTORS

This assessment of updated information for the Final Environmental Statement was prepared by the following:

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CONSULTANT

Battelle Pacific Northwest Laboratory, Fuel Cycle, Transportation, and Safeguards

APPENDIX N
COMMENTS ON THE
DRAFT SUPPLEMENT TO THE
FINAL ENVIRONMENTAL STATEMENT

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United States
Department of
Agriculture

Economic
Research
Service

Washington, D.C.
20250

AG

July 27, 1982

Mr. Paul S. Check, Director
CRBR Program Office
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Check:

Thank you for forwarding the supplement impact document for issuance of a construction permit to the Project Management Corporation (PMC), the Tennessee Valley Authority (TVA), and the U.S. Department of Energy (DOE) for construction and operation of the Clinch River Breeder Reactor Plant (CRBRP), to be located in Roane County, Tennessee.

We have reviewed Docket No. 50-537 and have no comments.

Sincerely,

VELMAR W. DAVIS
Associate Director
Natural Resource
Economics Division

C002^B

8207290187 820727
PDR ADOCK 05000537
A PDR

ETDD

B27



east tennessee development district

August 6, 1982

counties
anderson
blount
campbell
clalborne
cocke
grainger
hamblen
jefferson
knox
loudon
monroe
morgan
roane
scott
sevier
union

Mr. A. D. Burkhart, Manager
Licensing and Environmental
CRBRP Project
Burns and Roe, Inc.
800 Kinderkamack Road
Oradell, NJ 07649

Dear Mr. Burkhart:

cities
alcoa
blaine
caryville
clinton
cumberland gap
dandridge
farragut
friendsville
gatlinburg
greenback
harriman
huntsville
jacksboro
jefferson city
jellico
kingston
knoxville
lafollette
lake city
lenoir city
loudon
luttrell
madisonville
maryville
maynardville
morristown
new market
new tazewell
newport
norris
oak ridge
oakdale
oliver springs
oneida
parrottsville
philadelphia
pigeon forge
pittman center
rockford
rockwood
rutledge
sevierville
sweetwater
tazewell
tellico plains
townsend
vonore
wartburg
white pine

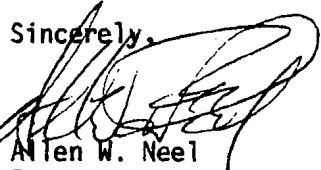
SUBJECT: Result of Regional Review
U. S. Department of Energy - Amendment XV to the
Environmental Report for the Clinch River Breeder
Reactor Plant

The East Tennessee Development District has completed its review of your proposal, in its role as a regional clearinghouse to review federally-assisted projects.

ETDD has no comments at this time on Amendment XV. However, ETDD or other reviewing agencies may wish to comment further at a later time.

We appreciate the opportunity to work with you in coordinating projects in the region.

Sincerely,


Allen W. Neel
Executive Director

AWN/tg

cc Mr. Mike Jones, Tennessee State Clearinghouse
Mr. Paul S. Check, U. S. Nuclear Regulatory Commission
Ms. Judy Orasky, CRBRP Project Office, Oak Ridge

ISA

The INDIANA SASSAFRAS AUDUBON SOCIETY

of Lawrence - Greene - Monroe -
Brown - Morgan & Owen Counties

August 17, 1982

TO: OFFICE OF NUCLEAR REACTOR REGULATION,
U.S. NUCLEAR REGULATORY COMMISSION

RE: DRAFT SUPPLEMENT TO FINAL ENVIRONMENTAL
STATEMENT, CLINCH RIVER BREEDER REACTOR

The Sassafras Audubon Society has reviewed the Draft Supplement to the Final Environmental Statement related to construction and operation of the Clinch River Breeder Reactor Plant (CRBRP), Docket NO. 50-537 and finds it unacceptable on grounds literally too numerous to mention. This statement will be limited to the issues of NEED and COST.

First and foremost, need for the CRBRP is not established in Chapter 8, NEED FOR THE PROPOSED FACILITY. In fact, only conjectures of its "possible" need decades hence are given as the *raison d'etre*, reason enough for our request that the NRC staff recommend in the Final Supplement that the CRBRP Project be canceled.

The NRC staff notes on page 8-2 that "Because of the long lead-times involved, even with vigorous pursuit of this plan (construction and operation of the intermediate size CRBRP), a commercially viable LMFBR and significant LMFBR market penetration are decades away." The staff also notes that there have been changes in the emphasis of the program, the most important of which is that the decision on deployment and commercialization of the LMFBR will be made by the utility industry.

Therefore, there is not only a question of need, but whether a nuclear power utility industry will even be around to contemplate such a decision decades hence. Not a single nuclear power plant has been ordered since 1978, while numerous projects have been canceled and more are under consideration for cancellation. The nuclear power market has evaporated home and abroad. Where is the need for the CRBRP?

What are the reasons for the decline of the nuclear power industry? It is universally admitted that the staggering costs of nuclear construction are not alone to blame, but that the continuing nation-wide decline in electrical demand is also responsible. The nation has an over-capacity beyond what is needed for peak demands. Conservation of energy and more efficient use of energy has been responsible in part for the decline in electrical demand with the clear potential of energy conservation and increasing use of soft-energy strategies lowering demand notably in the immediate future.

TVA, an applicant in the Clinch River Breeder Reactor Project, has "shelved" many nuclear power plant projects and is promoting energy conservation-energy efficiency in its service area. Its participation in the CRBRP Project is obviously politically directed.

ISA-1

With all this in mind, the NRC staff's statements to the effect that the consequences of the early development of the CRBRP, even at the risk of developing the option before it is economically competitive with LWR's, are minor compared to the risk

of possible electricity shortages and economic penalties associated with late development is irresponsible. On what evidence is the forecast of "possible electricity shortages" based?

ISA-2

The economic penalties will come with the construction of the CRBR and be borne by the American people, who will bear over 90% of the costs at best, and conceivably all of it. The projected cost of the CRBRP of \$3.525 billion is hopelessly over-optimistic in view of what it costs to build an LWR and in view of the enormous cost overruns being experienced in the French Breeder Program and those of Japan and other European nations. The final cost of the CRBRP is more likely to surpass \$7 billion.

The futility of further argument is obvious. The Nuclear Regulatory Commission has given DOE permission to start construction before the plant has been licensed for "safety". The Nuclear Regulatory Commission and staff are willing to give the administration what it wants whatever the law and whatever the evidence.

Yours sincerely,

Mrs. David G. Frey
Mrs. David G. Frey
2625 S. Smith Road
Bloomington, Indiana 47401

for Energy Policy Committee, SAS



DEPARTMENT OF THE ARMY
NASHVILLE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1070
NASHVILLE, TENNESSEE 37202

COE

IN REPLY REFER TO

FORNED-P

27 AUG 1982

Mr. Paul S. Check
Office of Nuclear Reactor Regulation
United States Regulatory Commission
Washington, DC 20555

Dear Mr. Check:

Reference is made to your 23 July 1982 letter concerning the submission of the draft Supplement to FES Related to the Construction and Operation of Clinch River Breeder Reactor Plant.

As requested, I have reviewed the draft supplement on the proposed project. The draft supplement adequately addresses the necessary changes in the program and the associated environmental impacts. A Department of the Army (DA) Permit Number 42,362 was issued to the US Energy Research and Development Administration on 6 May 1977. Special Condition (M) of the DA Permit, which addresses required commencement and completion dates, has been amended twice with the most recent dated 29 January 1981. The current permit condition requires that the authorized activities be completed prior to 6 May 1984. Should it become apparent that this deadline cannot be met, a request for extension should be made well in advance of the deadline.

I appreciate the opportunity to review the draft supplement on the proposed project. If I may be of further assistance, please contact Ms. Vechere Lampley of my staff at (615) 251-5028 or FTS 852-5028.

Sincerely,

E. C. MOORE

Chief, Engineering Division

rn



United States
Department of
Agriculture

Soil
Conservation
Service

675 U. S. Courthouse
Nashville, TN 37203

SCS

September 2, 1982

Mr. Paul S. Check, Director
CRBR Program Office
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Check:

My staff has reviewed the Draft Supplement to the Final Environmental Statement for the Clinch River Breeder Reactor Plant.

The supplement does not contain specific soils information, but our review of published soils information for this site shows that up to 25% of the site could be made up of prime farmland soils. However, since the site is federal property and has not been in agriculture other than forestry, the impact of using the site as proposed would be minimal to farmland.

The supplement notes on pages 4-6 that an Erosion and Sediment Control Plan has been developed by the applicant and that the EPA must approve it. On pages 4-27 there is a general description of activities planned to control erosion and sedimentation. We agree with these general statements and would be happy to review the detailed plan for adequacy.

The project does not impact on SCS assisted projects since it is on federal land. We do not find any severe soil limitations for the proposed action.

Sincerely,

Donald C. Bivens
State Conservationist



The Soil Conservation Service
is an agency of the
Department of Agriculture

THE NATURAL RIGHTS CENTER

156 Drakes Lane
Summertown, Tennessee 38483
(615) 964-2334, 964-3992
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NRCtr

September 6, 1982

Mr. Samuel Chilk
Secretary of the Commission
U.S. Nuclear Regulatory Commission
1717 H St. NW
Washington, D.C. 20555

RE: Comment on NUREG-0139, Draft FES Supplement to CRBRP, STN-50-537

Dear Sir:

This is a comment on the Draft Supplement to the Final Environmental Statement related to construction and operation of the Clinch River Breeder Reactor Plant, Docket No. 50-537, issued for public comment by the Office of Nuclear Reactor Regulation in July. I will not comment on matters raised by the intervenors before the Atomic Safety Licensing Board or by myself in limited appearances before that body.

Please observe that the Supplement identifies 13 species of wildlife which are potentially endangered by the Project and 3 additional species now under status review which may also be potentially endangered. The Fish and Wildlife Service has reminded the NRC that NRC has lead responsibility to review the extent of endangerment of these species.

There is one species currently listed among endangered species in Tennessee (Supp. at B-2) that does not appear on the Fish and Wildlife Service list (Supp. at B-4) which is confirmed as present in the area in Section 2.7.2, Aquatic Ecology. Table A2.2 lists species of fish taken from the Clinch River below Melton Hill Dam in the vicinity of the proposed CRBR site. On page 2-16 Percina caprodes, or Logperch, is listed. P caprodes is one of the species of reticulate longperch on the endangered species list at page B-2.

The Natural Rights Center is a public interest law project of Plenty International. Plenty is a non-governmental organization associated with the Office of Public Information of the United Nations. All donations are tax-deductible. The Center is staffed by and located within The Farm community, an international religious collective of 1,200 men, women and children who take common vows of poverty in service to the world. The purpose of the Center is to establish perspective about natural rights, including the rights of living creatures to enjoy habitat, wilderness and survival, the inalienable freedoms of generations still to come, and the power to bring about peaceful transformations of human values and dignity.

Please advise me as to the measures CRBRP will undertake to preserve the critical habitats of P. caprodes and the other species which are potentially endangered by this project.

Sincerely yours,

Albert Bates

Albert Bates

AB:wp
12:40 09/06/82

September 7, 1982

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
ATTN: Director, Clinch River Breeder Reactor Program Office

OCRE COMMENTS ON NUREG-0139 Supplement 1, CRBR, Docket No. 50-537

Ohio Citizens for Responsible Energy ("OCRE") hereby submits its comments on the Draft Supplement to the Final Environmental Statement (CP Stage) for the Clinch River Breeder Reactor, Docket No. 50-537. OCRE believes that there are a number of deficiencies in the statement, which, if corrected, would lead any reasonable person to the conclusion that the CRBR project should be terminated. Specifically:

- OCRE - 1
1. There is absolutely no need for CRBR. The breeder reactor is supposedly necessary to prevent a uranium/fission fuel shortage at some time in the future. This projected shortage is based on the old AEC's outdated projections of 1000 LWRs in operation in the United States by the year 2000. Obviously (and, in OCRE's opinion, fortunately) this goal will never be met. There are now about 70 reactors in operation with a similar number under construction. No new reactor orders have been placed since 1978. Cancellations of nuclear plants, even those under construction, have been numerous. Nuclear power plants, which are supposed to have a 40 year life, are currently suffering from problems (steam generator problems, pressurized thermal shock) which indicate that the useful life of these facilities is much less than was originally anticipated. Most utilities now realize that investing in a nuclear power plant is a quick route to bankruptcy, and that the promotion of alternatives and energy conservation is much more rewarding financially. The demand for electricity is also much lower than was predicted 10 years ago. Given these circumstances, it is likely that there will never be more than 140 nuclear reactors operating at any one time in this country. Thus, the postulated uranium shortage necessary to justify the breeder will simply never exist.

As far as the DOE's arguments for CRBR (see, e.g., 47 Fed Reg. 33771, August 4, 1982), these consist of assorted half-truths and other misleading statements, particularly with regard to the need for the facility. E.g., p. 33772, where the DOE states that 70% of this nation's energy comes from gas and oil. This conveniently ignores that fact that most of this gas and oil is used where electricity cannot be (and is used more efficiently than electricity is those applications where electricity is an alternative to direct combustion). Oil, for example, is used primarily for automotive needs. Only 6% of our electricity is generated by burning oil, and this is residual oil, that which is left after the refiners have removed all higher grades; its only other use is for

making road tar. DOE also makes a statement to the effect that coal may fail to meet expectations. This is absurd. Coal is not one of those far-out, futuristic energy sources. It is a proven fuel, with vast stores of it in America. It can be burned cleanly and cheaply. See, e.g., studies by Komanoff, Energy Systems Research Group, and others. DOE's support of the breeder while at the same time purposefully neglecting the funding and development of safe alternatives should automatically reject any claim it may have as an objective agency.

There is certainly no need for the electrical energy produced by CRBR. This should be obvious, since the TVA has recently cancelled nuclear power plants (Hartsville, Phipps Bend) in the same service region as CRBR.

OCRE-2 2. Safe alternatives definitely do exist to CRBR and to all nuclear energy technologies. It is OCRE's opinion that CRBR and all nuclear power generation should be abandoned and the vast sums of money squandered therein be used instead for the development of clean coal, solar, geothermal, wind, and hydroelectric energy sources and of better energy conservation methods. Incredibly, the Draft Supplement in Section 9.1 claims that there have been no changes in the availability of alternative energy sources since the FES, issued in 1977. The FES, in turn, cites ERDA-1535, issued in 1975, in reaching the conclusion that none exist. How the NRC can ignore the proliferation of alternative energy companies, plans, and publications since 1975 is beyond belief.

OCRE-3 3. Aside from nuclear weapons, the fast breeder reactor is the most dangerous nuclear technology known to mankind. That CRBR and other LMFBRs can suffer criticality accidents that can cause nuclear explosions is shown by The Accident Hazards of Nuclear Power Plants by Dr. Richard E. Webb (Univ. of Mass., 1976). The accident analysis given in Section 7 and Appendix J of the Draft Supplement is deficient because it neglects the work of nuclear critics like Webber and is based on unfounded assumptions. (Note: 10 CFR 51.26 (b) requires environmental statements to make meaningful references to opposing viewpoints.) The consequences of a LMFBR nuclear explosion are ignored. To think that evacuation is a responsible response in such a situation is ridiculous.

The operational record for American breeder reactors is not good. Both EBR-I and Fermi have suffered meltdowns. We were fortunate that these accidents did not have serious consequences. We may not be so fortunate with CRBR.

OCRE-4 4. The LMFBR also presents a threat to world security because it produces plutonium, used in nuclear weapons. The safeguards for the CRBR fuel cycle discussed in Section 7.3 and Appendix E of the Draft Supplement are of unproven workability. Totally neglected is the effect which a fool-proof safe-

guards system (if such is possible) would have on the civil liberties and freedom so cherished by Americans.

Also neglected is the possibility (a quite likely one) that the Pu produced by CRBR will be used to make U.S. nuclear weapons. Since the Pu is not needed for LWR technology (as shown in Item 1 above), and since the DOE was actively suggesting that the reprocessing of commercial LWR spent fuel should proceed to alleviate a Pu shortage caused by the Reagan administration's expanded defense program, OCRE suspects that this may be the real reason behind the DOE/Reagan support of the breeder. If this is so, it should be publicly disclosed. NEPA requires that the effects of this action be evaluated; this evaluation would have to include the consequences and likelihood of nuclear war. OCRE (and many other Americans) believes that the expansion of nuclear arsenals and the development of first-strike capability makes nuclear war more probable. If Pu from CRBR is intended to support the expansion of U.S. nuclear weapons, OCRE contends that this must be evaluated under NEPA.

OCRE-4

OCRE-5

5. The Draft Supplement totally fails to evaluate psychological stress in the residents around CRBR, as required by PANE v. NRC, 678 F.2d 222 (D.C. Cir. 1982). This stress should be significant, since CRBR presents a threat which is more severe than other nuclear technology, e.g., LWRs (examples of threats: special accident hazards of LMFBR and dangers of nuclear proliferation). The Commission's policy statement dated July 16, 1982 which precluded the consideration of psychological stress at sites other than TMI is illegal (see "OCRE Reply to Motion by Sunflower Alliance Inc. et al. for Reconsideration or in the Alternative Motion to Certify to the Commission," dated August 12, 1982, submitted in the proceeding In the Matter of Cleveland Electric Illuminating Co., et al. (Perry Nuclear Power Plant, Units 1 and 2) Docket Nos. 50-440/441 OL).

OCRE-6

6. The Draft Supplement's assessment of socioeconomic effects on the local communities (taxes and increased employment) is improper. The Appeal Board in Public Service Company of New Hampshire (Seabrook Station, Units 1 and 2) ALAB-471, 7 NRC 477, 479 (1978) held that increased employment and tax revenues to the affected community may not be counted on the benefit side of the cost/benefit analysis. The Draft Supplement in Section 10.4.1 gives these factors heavy weight.

OCRE-7

7. OCRE notes that Asiatic clams, Corbicula sp., are abundant in the vicinity of CRBR (Sec. 2.7.2 of the Draft Supplement). These organisms are known to cause biofouling problems at power plants (e.g., Arkansas Nuclear One and Brunswick). Neither the NRC nor the applicants appear to have considered the possible effects these clams could have on plant safety or the environmental effects of clam control measures. E.g., OCRE suspects that chlorination may be used to kill clam larvae. The amount of chlorine required may exceed EPA

standards.

- OCRE-88. The Draft Supplement does not consider emergency planning as required by 10 CFR 50.47. No mention is made of protective actions for the exposed public in the event of an accident at CRBR and whether they would be adequate with respect to the special accident hazards of the LMFBR. Similarly, no consideration is given to the economic burden emergency planning places on state and local resources.
- OCRE-9 9. The Draft Supplement's evaluation of the hazards of low-level radiation effluents is deficient because it neglects studies that indicate that radiation is more hazardous than was thought. (see Science News, June 19, 1982 at 405).
- OCRE-1010. Similarly, the occupational hazards of radiation exposure are underestimated. See Science News, July 17, 1982 at 39, which describes the dangers of low-level neutron exposure.

OCRE thus concludes that the costs, economic, ecological, and in terms of potential human suffering, of CRBR far outweigh any potential benefits. Whether any benefits exist is questionable. CRBR is a grand experiment in which the public is used as "Ginna pigs." Abandonment of this useless, dangerous, and expensive project is the only rational course of action.

Respectfully submitted,

Susan L. Hiatt

Susan L. Hiatt
OCRE Representative
8275 Munson Rd.
Mentor, OH 44060



United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

DOI

ER-82/1236

SEP 8 1982

Mr. Paul S. Check, Director
CRBR Program Office
Office of Nuclear Reactor Regulation
Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Check:

The Department of the Interior has reviewed the draft supplement to the final environmental statement for the Clinch River Breeder Reactor Plant, Roane County, Tennessee, as requested in your letter of July 23, 1982, and find we have no comments to make.

Sincerely,


Bruce Blanchard, Director
Environmental Project Review

LRC

West Runney Village
Runney, NH 03266
September 2, 1982

NRC
Washington, DC 20555

Att: Director, Clinch River Breeder Reactor Program Office

RE: Draft Supplement to the Final Environmental Statement
(NUREG-0139) for public comment by Sept. 13

My comment will focus on pp. 10-4 through 10-8, which addresses decommissioning of the CRBRP. The ALARA policy as it applies to this nuclear project and the costs of decommissioning draw my attention. While I make my comments on ALARA, they will take on a personal nature because otherwise the people affected by the CRBRP are successfully kept as statistics only.

LRC-1

1. ALARA stands for "as low as reasonably achievable" and on p. 10-7 it is worker exposure that will be handled ALARA. Yet it is health effects that will be ALARA. Terminal cancer and birth defects will be allowable at the CRBRP -- among the workers -- if only they are kept to a certain number that someone has determined is "reasonable." As former Comm. Peter Bradford pointed out during his term with the NRC, it is time to debate what is "reasonable" to suffer in exchange for nuclear-power-generated electricity.

LRC-2

2. To make the issue personal -- it must not be allowed to be kept only in the statistical realm -- I am about to receive employment because a local twelve-year-old boy has contracted cancer of the bone. His hip bone is affected, so there can be no amputation "above the next joint." He has had chemō-therapy, lost his hair and much body weight. No longer will John Church be on the Plymouth High School's cross-country or downhill ski teams -- a super athlete. So his mother, a teacher, can be at home with him in the mornings, I will take her morning teaching load. His father has curtailed his employment so he can be with John in the afternoons. One of these days John will simply die. If he is part of the general population the NRC covers with its ALARA policy -- and who can prove that he isn't? -- then who is it who determined it is reasonable for John and his family to suffer now while he slowly and painfully dies?

LRC-3

3. I oppose the ALARA policy wherever it is used as a rationale for the CRBRP's existence. I protest that not enough people realize how they are affected by ALARA.

4. As for the costs of any of the decommissioning procedures, the costs associated with TMI Unit 2 are conspicuously absent from this set of pages. \$4 billion has been given as cost to clean up TMI Unit 2, and we are now 3½ years past the time the accident there began. I receive the Middletown, PA, PRESS & JOURNAL and know the process is tediously slow, with any number or combination of surprises possible as the damage to the reactor core is revealed by equipment that is invented as the operation proceeds. Bechtel Corporation has also seen fit to launch a FUSRAP program -- a money-maker needed because TMI shows there will be accidents to clean up and former reactor sites to decontaminate. With Bechtel seeing the "market" as good enough for launch of FUSRAP, I criticize these pages on CRBRP's decommissioning as being naively optimistic that all decommissioning comes after a problem-free plant operation and the costs can be calculated early in the game. As a tax-payer I protest the use of tax dollars this way when social service programs for our country badly need funding.

LRC-4

Sincerely,

Lynn Rudmin Chong
Lynn Rudmin Chong

copies:

Peter Bradford, Maine Public Advocate
NH Rep. Barbara Bowler
NH Executive Councilor Ray Burton
NH Senator Gordon Humphrey

Washington Post

Please acknowledge
receipt of this comment
& put me on the list
to receive a compilation
of the comments & the
Final AS



LGW

THE UNIVERSITY OF ALABAMA

College of Arts and Sciences

Department of Biology

Home address:

1246 Northwood Lake

NORTHPORT, AL 35476

September 8, 1982

Home Phone 205-339-1535

Mr. Paul H. LEECH,
Director, Oak Ridge Reactor Programs
U. S. Nuclear Regulatory Commission
WASHINGTON, D C. 20555

Dear Mr. LEECH; Regarding US DOE Porject Management Corporation
Tennessee Valley Authority, Clinch River Breeder
Plant; US NRC Docket No. 50-537
"Comments in Supplements to the US NRC Atomic
Safety and Licensing Board-- Hearings at Oak
Ridge, Tenn. on February 14 and August 30, 1982.

After hearing from the NRDC today that final comments would be
accepted on Monday, September 13, 1982, I tried to reach you via
phone. The first time I did not make the connection. The second
attemp I made the call, but talked briefly with a secretary, since
you were out of the office for the balance of the day.

If you did not already receive my mimeographed handout of
February 14, 1982, one is enclosed, concerning US NRC (Atomic Safety
and Licensing Board & US Dept. of Energy, TVA Docket No. 50-537. I did
make limited appearances statements at the two hearings at Oak Ridge.

LGW-1

My principal concerns are not with the reactor safety, but with
management of the radwastes (low-, intermediate-, and high level) to
the environment, wpecially to the Clinch River, and to present and
future deposits of ionizing materials to the Clinch River, and to the
disturbance of high-level ionizing materials currently in sediments of
the Clinch River. My studies in the Clinch and Tennessee Rivers do
strongly indicate that alpha emitters have been far underestimated and
that the potential for chromosome aberrations to humans via the food
web from aquatic organisms is sorely in need of reevaluation. Any
dredging operation could make available huge amounts of plutonium and other
transuranics to the food web into domestic water treatment plants down
river and into the Tennessee River. Total alphas seem to vary, incresing
when stream flow is to deep bottom sediments, especially in the deep
resevoirs. This is reflected in resevoirs of the Tennessee River in
Alabama. Dermography statistics indicate higher incidence of cancers
associated with ionizing materials reaching humans via water supply
and by eating contaminated food. I hope that the NRC will now require
counts of chromosome aberrations for future evaluation of the levels of
allowable ionizing materials that are already cycling in the aquatic
ecosystem, and that bioassay toxicity will be used to evaluate unsafe
concentrations of heavy metals, also associated with the radionuclides
released to the environemnt.

319 BIOLOGY 205/348-5960 POST OFFICE BOX 1927 UNIVERSITY, ALABAMA 35486

Enc. - on Breeding Plutonium

N-16

Louis G. Williams, Ph. D.

Louis G. Williams

On Breeding Plutonium

(Not to be confused with polonium-210, which is an alpha emitter February 14, 1982
that is found in tobacco and in some phosphate fertilizers and causing some lung cancers)

The following concern where the Atomic Safety and Licensing Board of the U. S. Nuclear Regulatory Commission should allow the proposed nuclear breeder plant. Check one of the following:—

- () At Oak Ridge, Tennessee, and the proposed current site of TVA.
- () In central West Alabama, in or near the chalky storage or dumpsites for hazardous and radioactive wastes.
- () In Mississippi salt domes.
- () Do not know.
- () The TVA nuclear breeder program should be closed out for reasons of public safety and lack of cost effectiveness.

From:— Louis G. WILLIAMS, Ph. D.
Emeritus Professor of Ecology
P. O. Box 1927
University of Alabama, 35486
Home (mailing) address:—
1246 Northwood Lake
Northport, Alabama 35476
205-339-1535

To:—Atomic Safety and Licensing Board
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subjects:— 1) In the matter of the Clinch River Breeder Reactor Plant, U. S. Dept. of Energy, TVA, Docket No. 50 - 537

- 2) Instant licensing proceedings
- 3) Prehearing Conference, February 9-10, 1982, at Oak Ridge, TN, where I made an oral presentation before the NRC Atomic Safety and Licensing Board.
- 4) President Regan's budget request to congress contains \$252.5 million to be spent on the Clinch River Breeder Reactor Plant by the Department of Energy (DOE). Reagan also now recommends that the DOE be dis-

ALABAMA'S NUCLEAR ROLE

One scenario would have reprocessing and commercial fuel fabrication in Alabama, with possible fissile materials being generated for use in atomic weapons. This is plausible because of nearby approved (?) hazardous waste dumpsites available in Alabama, and because of the proximity of permanent storage sites for transuranics in Mississippi salt domes, all in less populated areas and near to most of the nuclear reactors in the U. S. Also, Westinghouse could recover spent fuel from its reactors around the world and use barges to transport spent fuel up river in Alabama for reprocessing.

INCOMING QUANTITY OF HAZARDOUS WASTE

A few years ago a hazardous waste dumpsite in Sumpter County was approved by EPA as the only toxic waste dump for the Eastern U. S. Hazardous wastes from 38 states and Puerto Rico were shipped into Alabama between March 1, 1981, and August 31, 1981, from 7,644 shipments. Alabama is a champion in both football and hazardous wastes. Now orchestration seems to be underway to make Alabama number one in working with high-level ionizing materials (uranium hexafluoride, spent fuel, atomic wastes from weapons development, reactor fuel rods, etc.).

Are the people of Alabama aware that Alabama's nuclear future could be set by agreements between the federal government and the legislature and governor of Alabama? On a cost/benefit basis Alabama gets the garbage and America gets the benefits. Some truck drivers have told me that they could have discharged their wastes in other states, but they preferred to bring them further to Alabama because we have the best dumpsites. Prior to November 1980, huge amounts of hazardous

(Ed. note, cont'd p. N-18)

(Ed. note, cont'd p. N-18)

mantled into departments of Commerce, Interior, and Justice. If congress approves, the funding for the LMFR will go to a proposed Energy Research and Technology Administration (ERTA) of the Department of Commerce. These funds for this breeder would go only for limited work authorization (LWA), such as site preparation, with no funds going for the actual construction of the breeder itself.

ALTERNATIVE SITING

The current Oak Ridge site could be rejected on the grounds that other sites, such as those in Alabama and Mississippi, would be more acceptable, or on the grounds that there is lack of suitable conditions at Oak Ridge for:— A) Emergency evacuation, B) No suitable storage or disposal sites for used nuclear fuel rods (spent fuel), and C) Lack of the kind of highways to handle trucks with heavy, hazardous wastes requiring specially constructed shipping cast containers to protect the driver and the public along the highway from irradiation and from dangerous nonradioactive chemical materials associated with the nuclear fuel cycle, D) Lack of public confidence in the safety, cost effectiveness, and performance of the U. S. breeder program, and E) Belief that fusion, not fission, should be the long-term priority for generation of electricity.

The Board may recommend to President Reagan that the LMFR program be terminated, but that further study should be made of the converter reactor as a method of generating fissile plutonium-239 and fissile uranium-233, respectively from fertile U-238 and thorium-232. This would greatly reduce the cost of nuclear fuel, but would put the U.S. in the plutonium economy, where plutonium could be used for making atomic weapons from current light water reactor spent fuel. President Reagan would have to decide for reprocessing for reactor fuel or warheads. A decision will have to be made for the long term storage of transuranic wastes.

(Continued on

wastes were buried in private landfills in Alabama and Mississippi that would be in violation of the Resource Conservation and Recovery Act after November 1980. Alabama and much of the Southeast has a wonderful resource in a giant aquifer. All dumps eventually leak. To Alabama uncontaminated water resources, surface and underground, will be far more valuable to Alabama than any part of the nuclear cycle industries. A cost-to-benefit ratio would certainly help a chemical or ionizing waste generator located in New York more than Alabama. Now who holds the liability forever?

PUBLIC PARTICIPATION

Some conservation and protect-the-environment groups like Waste Alert, Environmental Action, Pitch In and waste managers tend to promote unsafe methods. Some formerly effective groups become so infiltrated that they are ineffective. These groups have not sought methods of reducing the amounts of toxic, hazardous, and ionizing wastes that are being generated. Waste management is a most profitable business. However the orchestration for programs is underway to make Alabama the cloaca for both radwastes and chemical hazardous wastes. Finally PCB's with incineration at sea are becoming less of a threat. Projects for the future could make Love Canal and Three Mile Island small for what can take place in Alabama. Do we have to accept dangerous wastes from overseas reactors? Governor we can bring in more tourist but how do we make the future of Alabama beautiful?

OTHER POTENTIALITIES. If Alabama should be selected for a commercial LMFR, instead of the TVA breeder at Oak Ridge, the project manager for the TVA LMFR might like to use the federal handout of \$252.5 million to prepare a site without reactor components that would give the city of Oak Ridge free industrial advantages. reverse side)

Louis H. Williams

(Ed. note, cont'd p. N-19)

(Ed. note, cont'd p. N-19)

CHANGING POLITICS

Before the Carter administration put the breeder program on hold in 1977, the staff of the NRC had filed 21 contentions against the Oak Ridge LMFR. Now the Reagan administration is reinstituting the plutonium economy, including breeders, and reprocessing. The question now arises whether the breeder could be built without an impact statement and with instant permitting by the NRC. Many knowledgeable Oak Ridgeans say they are afraid of the breeder, in spite of the blitz to promote it. Apparently the breeder could be placed in Alabama with far less opposition. The risks, which are too great for Tennessee, could be acceptable in Alabama without being technically sound or safe, because the average citizen of Alabama is poorly informed about safety and cost effectiveness of the Breeder Program. Also, the governor of Alabama and/or the legislature are allowed by the NRC to give the go ahead without enough knowledge or without informing the public of the vast liabilities. Also, orchestration by the standard federal-state agreements would put Alabama, not the NRC, holding the bag for any foul ups.

ALABAMA STATE CONSTITUTIONAL AMENDMENTS

The current session of the Alabama legislature has passed a law calling for a statewide election on March 2, 1982, for modifying the constitution of the state by six amendments. Three of these proposals (4, 5, and 6) contain sleepers that most citizens of the state would not want if they were properly interpreted and understood. These amendments are concerned with management and investment of profits from leasing fees for oil and gas exploration of Mobile Bay, and in part are a bag of worms. Everyone in the state seems to favor upgrading the state highways and roads. However, some of the funds to build some highways would help to meet federal department of transportation standards in order that heavy trucks with 18 wheels may haul huge quantities of heavy, high-level ionizing materials to and from various factories of the nuclear fuel cycle and to disposal and storage dumps. One such proposal would upgrade the state highways connecting interstates 65 and 75 in Montgomery

cause serious burns, etc. Schemes to give all the hauling and safety contracts under control of special interests, could make for very unsafe conditions along highways and dumpsites by holding information from the public. The state would be responsible for maintaining clean and safe highways, but to whom does the liability belong in case of an accident?

DEREGULATION

The NRC and EPA are putting more controls under the State, leaving inadequate federal funding, monitoring and liabilities to the State. Unfortunately innocent citizens do not know when their future children are contracting birth defects, cancers, etc. The victims do the paying while the benefits may go to people out of range of the serious liabilities. Before pushing the bandwagon for more nuclear activities in Alabama perhaps Senator Denton should get us an abortion quickly, otherwise we could get sterility from too much ionizing radiation. We all have constitutional rights for ourselves and our grandchildren. Do children yet to be conceived have equal rights? One stop permitting on energy and environmental and safety issues could be dangerous to your health. Cost-benefit decisions could be your costs and their benefits. Historically decision-making has not looked enough at the whole ecological picture, not comprehended by many engineers and people engaged in business. Too much confidence in public hearings has now eroded because they are poorly attended, and are often staged for the media, and media personnel tend to be people not trained to report complex issues. Many action groups are now infiltrated with clever people carrying out the wills of the special interests.

Many of my statements over the years at many public hearings were not heard, but Three Mile Islands and Love Canals have proved me right. Now two-thirds of the nukes are closed down in the U. S. I attended and gave testimony at first hearings on Browns Ferry, Farley Nuclear

(Ed. note, cont'd p. N-20)

(Ed. note, cont'd p. N-20)

Louis B. Williams

with interstate 59 near Eutaw. This upgrade would pass through counties having deep deposits of Selma Chalk, which has made Alabama famous for accepting toxic and hazardous waste and some levels of radwaste, but not for high-level radwaste (spent nuclear fuel, trans-uranics), but alright for "temporary" storage of some high-level radwaste. The feds control the interstates, so that Alabama cannot stop unsafe trucking on the interstates. This network of federal and state highways would make Alabama a funnel from other states for movement of dangerous radwaste, chemical hazardous waste, fuel rods, spent fuel, enriched fissile materials including bomb grade materials.

FLUORIDE HAZARDOUS WASTE

The average citizen of Alabama is unaware that a proposed nuclear plant would bring into the state huge quantities of fluorine, the most corrosive substance on earth, which would remain in Alabama, while the fabricated nuclear fuel rods, containing huge quantities of high-level fissile materials and other radioactive materials, would be shipped out to reactors in the United States and to customers of Westinghouse reactors around the world.

Shipping containers hauled on trucks to shield high-level ionizing materials, are constructed to withstand up to 30 miles per hour, but truck wrecks do occur above 30 miles per hour. Truck highway accidents could result in many dangerous spills, when the shipping containers crack open on impact. Steel cylinders containing highly enriched uranium hexafluoride, coming into Alabama from uranium enrichment plants on trucks are better protected, but they develop cracks from corrosion and have been known to produce explosions and chemical fires, especially if someone tries to put out the "fires" by putting water on them. Adding water only would release more hydrogen gas, adding to the fires. All along these highways private citizens would have to be able to move quickly on very short notice in a direction away from the accident and not into it. These chemicals

Plant, Barton Nuclear Plant, an enrichment plant for Dothan, and a Westinghouse nuclear fuel plant for Prattville. Two of these did not get off the ground. I solved the Duckweed problem that choked the rivers from Birmingham to Mobile. While a professional ecologist for the USPHS (now EPA) I exposed Love Canal methods using species diversity and toxicity. My research on daily dumping of 67,000 tons of iron ore tailings to Lake Superior after 18 years finally led to safe, on-shore disposal. I was the senior scientist of the newly-formed National Water Quality Laboratory in Duluth, Minn., for this study. I helped to institute a code of ethics for pure and applied ecologists. However, the applied section of the Ecological Society of America is now dominated by engineers who tend to see too much of a specialist interest viewpoint. There is now a strong need for a three-way marriage among honest professional lawyers, engineers and ecologists. The hybrid from this three-way fertilization could give us more effectiveness and a more wholesome environment. When do we start?

HOME FOLKS

Causes for pollution can be a state of mind. Some people believe that living and working conditions when controlled by home people will be better. This could be true for some states. Some of the income from state oil and gas leases may be used to "train" Alabama personnel to work in extremely dangerous technology in nuclear and chemical industries, which could sacrifice people safety and environmental quality, which is allowed by federal-state agreement. Use of publicly-owned waste treatment facilities by nuclear industries could hurt treatment and be a large subsidy from taxpayers. There is no known way to treat radioactive decay. Discharges to public waterways from cities is the city's liability.

SS

102 Oakmont Drive
Kingsport, TN 37663
(615) 239-5828
September 8, 1982

Director
Clinch River Breeder Reactor Program Office
Office of Nuclear Reactor Regulations
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Sir:

I wish to comment on the Draft Supplement to the Final Environmental Statement on the Clinch River Breeder Reactor.

Analysis contained in the Draft Supplement of the impact on human beings, plants and animals contains limits of individual doses by an average exposure, in rems per year, without considering the cumulative effects of background radiation, which is received along with radiation from the Breeder Plant.

SS-1

Background radiation alone is believed to cause thousands of cancers per year. Additionally, your analysis seems to assume that radiation released into the river will be fully diluted and radiation released in the atmosphere will be uniformly dispersed. What is the basis for assuming this uniformity? Also, why are releases assumed to occur during average meteorological conditions rather than during a storm or period of temperature inversion? If noble gases and tritium are released, as planned, in the atmosphere, wouldn't a temperature inversion prevent the uniform dispersal which you assume?

SS-2

I would like to add that I am a victim of radiation exposure by the medical profession in 1957. As a result of that exposure, I had a thyroidectomy in 1977 -- 20 years after the exposure. I now have the condition of hypothyroidism which must be controlled by medication. The danger of all forms of radiation have been personally proven to me. There is no safe level of radiation. The hazards of the Breeder technology are very real. No matter what information you attempt to use to mislead the public, you cannot fool me. I will not permit you to waste funds on the Clinch River Breeder Reactor which will poison all of us.

SS-3

Sincerely,

Mrs. Suzanne Sherbondy
Mrs. Suzanne Sherbondy

Marvin I. Lewis
6504 Bradford Terrace
Phila PA 19149
215 CU 9 5964/725 7825

MIL

Secretary of the Commission

USNRC

Washington, D.C. 20555

Dear Mr Secretary ;

Please accept the following letter as my comments on NUREG 0139 DEIS Supplement number 1 Clinch River Breeder Reactor.

MIL-1 The cost benefit ratio is positive in this supplement for the same reasons that the cost benefit ratio was positive in the original DEIS; the assumptions are biased in favor of the CRBR.

MIL-2 Major alternatives: This only looked at Sites , Facilities and Transmission routes. Major alternatives did not look at the question of doing without the CRBR technology and substituting conservation and alternative renewable sources. This type of truncation is essential in making the poor CRBR technology look attractive. Electric power production: This is taken as a surety. There is no risk factor that the CRBR will produce at least this amount of electricity. However, the FERMI breeder produced almost no electricity; and the French and Russian breeders have been plagued by fires and other operating difficulties. There is at least a historical factor of 1/3 that this breeder will produce no electricity , and that this breeder will produce much less than it was designed to produce. This risk factor is ignored in the cost benefit ratio as it causes the cost benefit ratio to become negative

MIL-3 Probabilities of Class 9 accidents: The probability of a criticality accident is still ignored . The rationale is the design that supposedly will not allow a criticality to occur in a meltdown. Perhaps this design will operate as designed in a meltdown, but there is no experimental or experiential data to support this assumption. There must be some probability that a criticality can occur, this probability must be supported by experiment and data, and this probability must appear in the cost benefit ratio. It still does not.

MIL-4 Finally the EIS still ignores the political in toto. If the US spends this amount of money on an outdated , unproductive Moon doggle, what will keep every senator from trying to get his part of the porkbarrel? Will this escalation of porkbarrelling eventually weaken all of America/s resouces to the point that we will succumb to our own greed and not the forces of a foreign power? If we spend so much of our investment on a porkbarrel , will we have enough to spend on necessary research? These are the questions that must be answered.

Respectfully submitted,

M. I. LEWIS
6504 BRADFORD TERR.
PHILA PA 19149

N-22

Marvin I. Lewis

CSE

**CAROLINIANS
FOR
SAFE ENERGY**

P.O. BOX 8165
ASHEVILLE, N.C. 28814

September 10, 1982

U.S. N.R.C.

Paul H. Leech, Director
Clinch River Breeder Reactor Program
Washington, D.C. 20555

Clinch River Breeder Reactor
July 1982 Draft Supplement

This organization, in its concern for the safety of the American people, and the danger to the world by the uncontrolled dispersal of plutonium expresses its opposition to the Clinch River Breeder Reactor.

A plutonium breeder reactor will produce 2,000-4,000 pounds of plutonium every year. Only 12 pounds of plutonium is required to manufacture an atomic bomb of the size that destroyed Nagasaki. The Clinch River Breeder Reactor represents a step towards a breeder economy, in which hundreds of tons of plutonium would have to be stored, processed, and transported worldwide. There is an unacceptable risk that plutonium could fall in to the hands of unstable nations or terrorist groups equipped with the relatively accessible knowledge needed to fabricate nuclear weapons.

The Clinch River Breeder Reactor must be halted for this reason alone although other factors such as health and safety consequences, radiological impact, economic folly are significant and sufficient cause that this project not be allowed to proceed.

Sincerely,

Rubin Falk

Rubin Falk, Pres. CSE

DOE



Department of Energy
Washington, D.C. 20585

Docket No. 50-537
HQ:E:82:030

SEP 13 1982

Mr. Paul S. Check, Director
CRBR Program Office
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Check:

COMMENTS ON NRC CRBRP FES SUPPLEMENT

The enclosure to this letter contains the Applicant's comments on the Draft Supplement to the Final Environmental Statement for the CRBRP (NUREG-0139, Supplement No. 1, July 1982). These comments are provided in response to the July 30, 1982 Federal Register notice (47 FR 147, page 33302). In our opinion, the Supplement presents a satisfactory description of environmental impacts expected during construction and operation of the CRBRP. The enclosed comments are presented for consideration in the preparation of the Final Supplement.

If you have any questions, I would be pleased to respond.

Sincerely,

A handwritten signature in cursive script that reads "John R. Longenecker".

John R. Longenecker
Acting Director, Office of the
Clinch River Breeder Reactor
Plant Project
Office of Nuclear Energy

Enclosure

cc: Service List
Standard Distribution
Licensing Distribution

APPLICANT'S COMMENTS ON DRAFT SUPPLEMENT
TO FINAL ENVIRONMENTAL STATEMENT,
CLINCH RIVER BREEDER REACTOR PLANT
(NUREG-0139, Supplement No. 1)

LOCATION

COMMENT

Page iii,
Line 29

Correctly state the plant size by chang-
ing "380" to "375".

DOE-A

Page iii,
Lines 30, 32 and 33

Delete "and 439 MWe" and last sentence
which states "Inplant uses of electricity
would result in a net plant output of
approximately 350 MWe initially and 379
MWe in the future."

DOE-B

Page 2-6,
lines 25 and 26

Delete sentence.
("There would also be some spoil areas
in the floodplain."). Spoil areas will
not be located in the floodplain.

DOE-C

Page 2-6,
lines 29-31

Delete these sentences. Add: "All but
one of the six treatment ponds will be
removed after completion of construc-
tion."

DOE-D

Page 2-18,
1st full paragraph

Add a discussion of the recent TVA Sauger
Spawning Study (summary attached).

DOE-E

Page 2-19,
Lines 26-28

Delete sentence. Replace with the
following: "In conjunction with field
work for the Sauger study, one single
adult blue sucker was collected and
returned to the Clinch River on April 19,
1982."

DOE-F

Page 3-18,
Lines 17-19

For consistency with project plans, delete
the clause "and sent to runoff treatment
ponds (ponds A, B, and D) for removal of
suspended solids prior to discharge to
the Clinch River" and insert "and routed
to the Clinch River for discharge. Pond
C will be retained after construction for
collection of runoff from the vehicle
parking area."

DOE-G

Page 3-20,
Lines 6-8

Replace the sentence, "Prior to con-
structionand the NRC" with
"Coordination with the State Historic

DOE-H

DOE-I Page 3-20,
Lines 11-14

Preservation Office was completed in May 1982 for the off-site portions of the expanded transmission line right-of-way. No field survey was required because records and past experience for the area and for the terrain show no significant potential for sites in the zone to be affected."

DOE-J Page 4-26,
Line 8

Replace the sentence, "Should these archaeological.....be considered (ER Sec 3.9.6)" with the following: "Should any significant site be revealed in, or in the close vicinity of the center line, relocation of the center line, relocation of specific towers, or possible excavation will be considered and done in consultation with the State Historic Preservation Office and the NRC."

DOE-K Page 4-27,
Line 22

Blasting will be scheduled during the first and second workshifts to avoid disturbances during normal sleeping hours, rather than "during hours of about 3:30-6:30 pm".

DOE-L Page 4-28,
Lines 3-7
(Item 17)

Replace "burlap" with "mulch" to coincide with project construction planning.

DOE-M Page 5-20,
Table A5.5
(see also
Page 5-14)

Delete first sentence and replace with the following: "Offsite transmission line rights of way have been coordinated with the State Historic Preservation Office, indicating that no significant potential for sites exists in the affected area." Replace "corridor" with "center line" and "route" with "center line" in second sentence.

The 1,000 person-rems annual occupational dose estimate appears to be greatly over-conservative. The PSAR estimate of 400 person-rems annually is itself considered to be highly conservative for an LMFB. For example, occupational exposures for EBR-II range from 8 to 23 person-rems per year (1969-1981) and Phenix occupational exposures range from 4 to 15 person-rems annually (1974-

1980). Occupational exposures for CRBRP will be lower than for LWR's due to the use of the intermediate heat exchanger system, the remote refueling system (CRBRP's head stays on), and the fact that shielding is based on ^{24}Na , although maintenance will be performed after the bulk of this radioactivity decays.

Page 6-17,
Lines 20 and 21

The requirement for performing quarterly primary work force surveys is believed to be unnecessary. It is proposed that surveys be required once each year, or after a change in the primary work force of 1,000 employees during any 12 month phase of the construction. This reporting frequency is more reasonable since the size of the primary work force changes incrementally during the construction period. Surveying when these changes occur should result in the collection of data that would provide demographic-sociological statistical indicators essential for identifying significant changes within communities. A provision should also be included that allows for future modifications to survey data, survey frequency and reporting frequency to respond to specific needs that may arise throughout the term of the socio-economic monitoring program. DOE-N

Chapter 9

Beyond the analysis of the four representative candidate sites within the TVA service area which is discussed in Chapter 9 of the draft supplement, an additional alternative siting analysis was completed in June 1982 which used the approach set forth in NRC's proposed rule on alternative sites (45 Fed. Reg. 24,168, 1980). In addition to the candidate sites located at Hartsville, Phipps Bend, Yellow Creek, and Murphy Hill, the sites located at Spring Creek, Blythe Ferry, Caney Creek, Taylor Bend, Buck Hollow, and Lee Valley were also studied, taking into account the environmental parameters set forth in the proposed rule. After comparison of the Clinch DOE-O

River site with each of the above alternative sites, it was concluded that none of these sites was environmentally preferable to the Clinch River site. This analysis can be found in Attachment 1 to Appendix G of the CRBRP Environmental Report and is consistent with the NRC's conclusions regarding the absence of environmental preferability of the Hartsville, Phipps Bend, Yellow Creek, and Murphy Hill sites compared to the Clinch River site.

DOE-P Page 9-2,
lines 32 and 33

Change "11 TVA" to "all TVA steam." Add "(i.e., those expected to be operational on a time schedule consistent with planned operation of the LMFBR demonstration plant)" after "plants." Replace "Longenecker 1982d" with "ER Appendix G."

DOE-Q Page 9-2,
lines 35-38

Replace "120" with "set of hook-on and new." Delete "and environmental ... included poor" and replace with "considerations such as."

DOE-R Page 9-4,
Table A9.1

Add the Elk River (small, impounded -- interior low plateau).

DOE-S Page 9-7,
lines 32 and 33

Replace "had been found suitable for a nuclear plant" with "emerged as candidates from the screening analysis of the 109 potential new sites."

DOE-T Page 9-9,
lines 1 and 2

Replace "partially constructed or planned facilities are cancelled" with "projects were cancelled, TVA would no longer need them as inventory sites."

DOE-U Page 9-9,
Lines 14-17

Change sentence to read "Whether the cleared areas at Hartsville, Phipps Bend, Yellow Creek, and Murphy Hill will become available is unknown and can only be speculated about at this time."

DOE-V Page 9-11,
lines 7 and 8

Revise to -- "1982c, Attachment 2). The only sites acquired by DOE since 1977 that would be adequate for the LMFBR demonstration plant (i.e., at least 300 acres) are committed to other programmatic uses."

Page 9-12,
Bottom Line

The stated estimate of \$350 million (YOE) for plant revenues is incorrect. Applicant's calculations project a revenue of \$679 million (YOE). Also, the basis for the estimate of revenue at the Hanford site (\$1097 million) appears quite high since power rates in the Hanford and Clinch River areas are expected to be roughly equivalent during the period in question.

DOE-W

Page 9-13,
Table A9.4

The water supply costs at the Hanford and INEL sites should be included. (\$1M, see ER Table 8, Appendix F, Amendment XV).

DOE-X

Page D-32,
Table D.16

Change from "Spent Blanket" to "New Blanket" (under A.). Transport worker exposures for Spent Blanket (0.018) and HLW (0.005) appear to be too low by several orders of magnitude. Correct totals after correcting these.

DOE-Y

Pages J-6,
and J-8
(Table J.2)

There appears to be some inconsistency in the grouping of the primary system failure categories (I, II, III, IV) in Table J.2. Table J.2 and the text should be reconciled.

DOE-Z

Page J-17,
line 10

Change "more" to "less" to reflect the intent of this sentence.

DOE-AA

Pages L-4 and L-5
(see also Page L-12,
Paragraph 6; Page L-18,
Paragraph 4; Page L-25,
Paragraph 3; Page L-31,
Paragraph 4)

It does not appear that the same basis for population to river flow ratios was used in comparing alternate sites from the perspective of population exposure to drinking water (i.e., Hartsville and Murphy Hill used total population within 50 miles whereas Phipps Bend, Yellow Creek, Hanford, and Clinch River used only the population adjacent to the river within 50 miles).

DOE-BB

Page L-7,
line 10
(see also page L-20,
line 20, and page L-27,
lines 1 and 2.

Although these intakes are "substantially completed", those portions in the rivers aren't completed yet and thus impacts on aquatic biota haven't occurred yet either.

DOE-CC

DOE-DD Page L-9,
Lines 36-39 and 44

The discussion of labor force availability incorrectly concludes that the Hartsville site is preferable to the Clinch River site. It appears that this conclusion may rely on the incorrect assumption that the labor force is equal available within the 50-mile commuting radius for all sites. For example, Davidson County is on the fringe of the 50 mile commuting radius for Hartsville while Knox County is much closer to the Clinch River site. Assuming that the propensity of workers to commute to a work site declines as the commuting distance increases, the Clinch River site would be preferable. Also the fact that over 500,000 people live within 30 miles of the Clinch River site and only 160,000 within 30 miles of the Hartsville site (see Table on Page L-10) would provide further proof that the Clinch River site is preferable from the viewpoint of labor availability.

DOE-EE Chapter L

The LMFBF demonstration plant site at the INEL is about 7 miles east - northeast of the EBR-II (Page L-40, line 23), not 13 miles east (Page L-36, line 19). The Loss of Fluid Test (LOFT) facility is in the northwestern part of the INEL, approximately 20 miles from EBR-II, not "near the center of the reservation" (Page L-36, line 43). The earthquake acceleration value at the EBR-II is 0.22g. Thus the relocation costs for the INEL site should be comparable to those of the other alternative sites for the LMFBF demonstration plant.

Summary - TVA Sauger Spawning Study

DOE-FF

In March 1982, TVA initiated a Sauger spawning study to determine the extent and location of sauger spawning in the vicinity of the project site. An extensive field investigation was conducted between March 29 and May 14, 1982. Emphasis was placed on the area from Melton Hill Dam (about CRM 23.0) downstream to about CRM 14.0. The CRBRP site is located between CRM 14.5 (barge unloading facility) and CRM 18.0 (intake). Considerable effort was also expended in the stretch of river from CRM 14.0 downstream to CRM 9.0.

Preliminary Findings as of August 12 indicate:

1. Adult sauger were found throughout the study area from late-March through mid-May. Few sauger were collected below Gallaher Bridge at CRM 13.0. Greatest concentrations (based on gill net samples) were found at CRM 16.0, but large concentrations were also found rather consistently at CRM 16.8, upstream from Grubb Island to Jones Island, and downstream near the barge unloading facility site. It could be inferred that spawning occurred to some extent whenever males were congregated during the spawning season.
2. Spawning probably takes place over a period of about two months with a peak in spawning activity in mid-April.
3. Males greatly outnumbered females throughout the study period.
4. Nearly all immature female sauger collected were found at the dam.
5. Ripe and flowing (eggs flowed readily with pressure) females were found at several locations from Gallaher Bridge to the dam. However, this does not necessarily mean the fish spawned in those areas. Radio tagged fish sometimes moved several miles in a couple of hours, thus it is possible that flowing females were collected several miles from where they would have spawned.
6. On only one occasion was there evidence of spawning actually taking place. At CRM 16.0, a female found in a net was extruding eggs and was surrounded in the net by several males. It appeared they were in the act of spawning as they encountered the net. On another occasion near CRM 19.5, a female was observed extruding eggs as the net was lifted. Direct observation using SCUBA failed to locate any sauger eggs on the substrate.
7. Sampling for sauger eggs was carried out over a period of several weeks. A benthic sled (specially designed with a water jet to dislodge eggs adhering to the substrate or lying in crevices) was effective in collecting benthic organisms and likely would have collected eggs if they were present. In many cases, the samples were relatively clean and, if present, the eggs could be readily seen in the sample jar. In other cases, sand and debris hampered direct observation in the field. Only a few sauger eggs were observed in sample jars in the field. Most samples were preserved and are being examined in the laboratory. Approximately 90 percent of the samples have now been processed, and it is apparent that few sauger eggs were collected in the study area from the dam to just downstream of the proposed site for the barge unloading facility.

8. An estimated 20,000 to 30,000 laboratory obtained fertilized sauger eggs were deposited on one occasion in the river at a marked location. The eggs were deposited during a period of zero river flow and the eggs sank directly to the bottom. Less than two days later an intensive search at the site was conducted using SCUBA. No eggs were observed. Repeated tows with sleds were then made in the area. No eggs were observed in the sample jars during field observation. However, at least one sample contained seven eggs when examined in the laboratory.
9. There seems to be considerable upstream-downstream movement throughout the area by individuals, and spawning may be occurring over several miles of river. However, since there were few sauger collected below CRM 13, it seems clear that sauger spawning is mostly confined to the stretch of river between Galaher Bridge and Melton Hill Dam. A final report of the sauger investigation will be completed in early 1983.

Mary Sinclair
5711 Summerset Drive
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September 10, 1982

MS

Comments on Clinch River Breeder Reactor Project,
Draft Supplement to Final Environmental Impact Statement

In the course of my graduate work at the University of Michigan, I often attended seminars at the Nuclear Engineering Department. I often heard the Clinch River Breeder discussed as a much more inherently dangerous project than the light water reactors. This is generally agreed on by all nuclear engineers. I also have heard engineers state that the Clinch River Breeder design ~~was~~ hopelessly outmoded--and this was 10 years ago.

MS-1

The many kinds of serious problems that have been encountered by the French in their Phoenix breeder project are among the reasons France has drastically cut back on planning on nuclear power for energy for the future. They have also had broad political repercussions in that country and in neighboring West Germany.

The draft supplement of the FES for Clinch Breeder does not adequately consider the health and safety consequences of sabotage, terrorism or theft. There is no adequate discussion of programs contemplated to mitigate these consequences and no credible methods are discussed for implementing these programs. The three criteria in Sec. E.1 do not consider the social impact or disadvantages, or probability or consequences of failure of the security measures proposed.

MS-2

Safe Secure Transport (SST) is not a feasible concept since so many methods of derailing a train or blowing up a truck are possible that would disperse plutonium to the countryside.

MS-3

In the section discussing the decommissioning of Fermi #1 (10-7), no mention is made of approximately 1,000 pounds of solid, plutonium contaminated sodium that is lodged in the pipes and containment of the plant that no one has been able to get out. This is a permanent, serious rad waste disposal problem that should be addressed at a LMFBR.

MS-4

Respectfully submitted,

Mary Sinclair
Mary Sinclair

WE

718-A Iredell St.
Durham NC 27705
Sept 11, 1982

Paul H. Leech, Director
Clinch River Breeder Reactor Program
USNRC, Washington, DC 20555

re: COMMENTS ON DRAFT SUPPLEMENT TO CLINCH RIVER BREEDER FEIS
Docket no. 50-537

WE-1

This draft is evidently a rush job, incomplete and sloppy in its analysis (or totally lacking in it). For example, at pp J-3 and J-4 concerning the likelihood of Class 9 accidents, we read that the Staff analysis of loss of heat sink (cooling) is not complete but their judgment is that it is less than 10^{-4} (one in 10,000) per year. No reason is given there. On page J-4 re loss of the 2 reactor shutdown systems simultaneously "although the staff review of these systems is not complete, it is the judgment of the staff ~~that~~ ... to expect an unavailability of less than 10^{-5} per demand. * * * Using the assumption, based on LWR (Light Water Reactor) experience, that an average of about 10 transients (requiring scram) might occur per year of operation over the life of the plant, the staff concludes that the combined frequency of degraded core accidents ... is less than 10^{-4} per year." In other words, ~~xxxx~~ NRC has not done the analysis required to back up these numbers-- they are guesses based on admittedly incomplete analysis -- and they incorporate LWR experience (vastly different type of plant, ^{with many} entirely different causes of reactor transients, different cooling material in primary system, etc etc).

WE-2

And what if an accident happens? Well, (pp J-5 and J-6) the analysis of the most serious (III and IV category) reactor releases caused by or including re-criticality, the staff hasn't even done the analysis (P. J-6), but if they do and it reveals problems, they will require some uncertain corrective action based on designs for the Fermi (partial melt, 1966) breeder

and an unbuilt General Atomic design. The staff "believes that the technology exists to design and build such devices."

Can the radioactive waste from these una~~na~~alyzed core re-criticality accidents escape containment. "Maybe" would be an honest response, but the Staff says (p. J-7) that "an unavailability of 10^{-2} per demand is feasible for such systems" (no statement why) and is "expected to be attained at CRBRP given that implementation of an adequate reliability program would be required."

In other words, we think it can, we're not sure why, and we will require CRBRP to have an "adequate reliability program" of testing to make sure the containment would work.

But don't worry, folks, the coolant sodium will just oxidize and adsorb or chemically react with most of the nasty radioactive fission products if a release occurs (PP J-7 and J-9). No mention there of the heat to be generated by 1 million pounds of primary coolant sodium (up to that amount can be released if the reactor and containment fail, allowing that much ~~sodium~~ ^{sodium} to contact air) reacting with oxygen. What will the heat generated in this reaction do? Elementary chemistry says it will increase pressure of the remaining gases (nitrogen from air, Xe, Ar, Kr, etc from the core) and blow them out of the ~~xxxx~~ containment.

Interestingly, the analysis is Rasmussen-type (event tree) with the events not as well identified or~~xx~~ analyzed as in WASH-1400. even though (as noted on page J-19) NRC has rejected the use of the accident risk and fatality probabilities from certain LWR designs that WASH-1400 asserted. The analysis here is much sloppier and uncertain, and much of it, as noted above, hasn't even been done. What you need to do, and have not done, is Failure Modes & Effects Analysis. This is particularly important if CRBR is going to use 11 different steam generators (lots of different ~~transients~~ to analyze).

Each type of system (including S.G.s) should be analyzed to find its possible failure modes and their consequences. This is a very complex task, but it is surely better than multiplying estimated judgmental fudge factors together, which is what NRC Staff has done in its estimation of CRBP Class III accident probabilities and consequences. Obviously, the methodology is no good if it is based on numbers which lack adequate basis and are therefore no good. Interestingly, the "analysis" is all in even powers of 10; no " 3×10^{-5} " numbers occur. This is a sure sign of lack of certainty equal to about one order of magnitude in each estimate -- i.e. the analysis was not sufficient to get closer than a given power of 10. Thus, each probability realistically has a "spread" from about 3 times itself to about 1/3 of itself. Multiplying 3 or 4 such probabilities (you can't realistically call them probabilities-- they are guesses or fudge factors, as is obvious from the report App J) together then has a cumulative uncertainty of (up or down) $1\frac{1}{2}$ or 2 orders of magnitude -- a factor of 31.6 to 100. Even NRC does no more than say it has done "limited quantitative analysis" (p. J-18) to give a "best estimate" of 10^{-6} accidents exceeding 10 CFR part 100 guidelines per reactor year (other estimates are not much in ~~xxxxxxx~~ evidence in the discussion).

WE-6

Assuming that has any validity, look at Table J.5, where the early fatalities are estimated 6×10^{-6} per reactor-year. That implies that if there is an accident, there would be 6 fatalities ^{million} early, and a total cost of \$690 (1980 dollars) for all cleanup -- but recall the uncertainty factor of 100 or so in the accident risk. That implies 600 early deaths are possible.

The destruction of the plant is estimated at 10^{-4} chances

per year, no uncertainty given. Yet the estimate of \$952 million WE-7
(1980 dollars) cleanup value "including replacement of the damaged
nuclear fuel" (how about a damaged blanket and a new containment
building if the accident breaches same) is less than the Three
Mile Island cleanup is expected to cost. (p J-17). That just
isn't credible. CRBR involves much more plutonium, dispersal of
aerosols, and technical capabilities to clean up such an accident
are not well developed. Surely the cost of developing them will
raise the cost.

In sum, the Class IX accident analysis is not analysis, it WE-8
is fudge factors. Costs of cleanup are clearly underestimated
for the reactor, and the offsite decontamination estimate takes
no account of lowered property values, inability to farm land
until (if) it can be decontaminated, possible adverse effects
on unique facilities such as ORNL and the Y*12 plant and others
nearby, e.g. Oak Ridge Gaseous Diffusion Plant. A CRBR
serious release could contaminate the heart of US nuclear industry.

II. "cost-benefit"

Fuel savings (see p J-17) are estimated at \$27 million per WE-9
year for TVA in 1990 dollars. Using a 10% discount rate (the
one employed in making that analysis and changing other 1980 and
1990-dollar values into one another's terms), that means a
1980-dollar value for yearly fuel savings from CRBR of under \$11 million
per year. The operation of CRBR at all is no way certain. But
assuming it is built on schedule and at current cost estimates
(both crazy assumptions for a nuclear reactor of any sort, much
less an experimental plant for which accident analysis is incomplete
and much modification may be required, see above section), it is
set to operate only 5 years (DS/FES Summary and Conclusions, p. iii)
and any further operation depends on TVA's buying the CRBR (ibid.).

WE-9

TVA has recently cancelled ^(four) ~~the~~ large nuclear units formerly ~~xxxx~~ scheduled for operation in the 1990s. It is extremely unlikely that TVA will need additional power in that time period; indeed, 4 more TVA nuclear units in that time-frame (1990s) for commercial operation are currently deferred and may be cancelled.

Moreover, TVA's growth in peak demand per customer went flat (to zero, effectively) in 1970 and has begun to decline. With national ^{sur} ~~xxxx~~plus capacity for electric generation running 35% (1981), and considerable additional capacity both conventional coal and LWR nuclear still under construction (total approx 100,000 MWe) it is highly unlikely that TVA can sell significant amounts of surplus power at any distance from TVA due to transmission losses. (See Eddleman testimony, cross by NC Textile Mfrs Assn, NC Utilities Commission Docket No. E-100 sub 41, 1980). Moreover, even if all 8 nuclear units noted above bite the dust, TVA still has the Sequoyah (2 units) plant in testing and fixing-up stages, plus 4 more units (Watts Bar 1 & 2, Bellefonte 1 & 2) under construction, with a total capacity (if they work and are all completed) of about 7000 MW. TVA sales are not growing significantly in their own territory, and the output of 7000 MW assuming a 50% capacity factor (slightly less than present US and world nuclear average, lowered because of larger plants' observed tendency to lower CF for PWRs, also because high thermal levels of large plants, e.g over 3000 Mwt or 1000 MWe tend to produce more transients that require shutdowns to assure core cooling capability is continuously maintained to withstand a severe accident) would be about 30 billion KWH per year, enough to supply an additional electric utility the size

of Carolina Power & Light Co. today (sales right at 30 billion/yr). The probability that TVA will add that much base load, given power costs from these plants, by 1990, is minimal. TVA base load has actually been shrinking under the pressure of rate hikes (3 of 13% in the last 2 years, one smaller one pending now) and declining uranium enrichment power use due to the demise of the nuclear industry. (cancellations outnumber orders in the USA by about 5 to 1 since 1974 for nuclear plants to be built)

I am an energy consultant and have a track record of predictions that compares favorably with those of the North Carolina utilities (see NCUC Dockets E-100 sub 35 (1979), sub 410 (1981) and E-2 sub 444 of 1982). Given the ~~x~~ availability of massive amounts of energy conservation investments more cost-effective than the Watts Bar and Bellefonte nukes (which will come in around \$1000/KW if completed, implying lifetime operating costs of around 3 cents/KWH), whereas most such conservation schemes cost between $\frac{1}{2}$ and 3 cents/KWH, there is not much likelihood that TVA can sell the output of these nuclear plants, much less CRBR. In other words, the chance that CRBR power will be needed is very small. I'm tempted to parallel the NRC's fudge factor method and facetiously "limitedly quantify" that probability as between 10^{-3} and 10^{-6} . Basis, my judgment. Remember, these numbers are a joke, but the analysis above is most serious. Failure to figure those sorts of facts out will cost TVA customers billions.

That also means that TVA is very unlikely to have spare funds to buy CRBR, which has a 1982 present worth (if costs do not rise in the future) or \$3.4 billion of which about \$2 billion is already spent. Converting to 1980 dollars at 10% (NRC uses 8%) (DS.FES p. 10 - 11, gives about \$2.8 billion.

WE-10

WE-11

WE-11

What value do we receive from a \$2.8 billion (1980 \$) investment in CRBR? \$11 million a year in fuel savings for 5 years (unless TVA comes up with ^{\$11.2} ~~\$7~~ billion in the year 1995 to buy it. That is \$3.4 billion escalated 10% per year for 13 years from 1982 to 1995).

To get the \$11 million in fuel savings, you need a 76.5% capacity factor (as assumed by NRC, DS.FES p. 10-10, using 350 MWe capacity. The plant's electric output could be raised to a net of 379 MWe (plus 60 MWe for station loads to run the plant) (p. 111), an increase of over 8 percent (but less than 9%). However, the use of a 76.5% capacity factor for an experimental~~x~~ plant is ridiculous. This number was raised from the 68.5% used in the FES of 1977, which is itself too high. There is no analysis of the plant's startup and shutdown characteristics, expected number of transients requiring shutdown (~~guess~~ guesstimated at 10 per year based on LWR experience; no analysis of breeder experience or experimental plant experience with other types of nuclear-electric production) or plant design to support this conclusion. There is just a naked number.

WE-12

Realistically, new LWRs are being figured at about 60% CF during initial operation, and we have 25 years of LWR experience including about 10 years with new large ones, although there is little LWR experience over 1000 MWe except for BWRs. (60% CF: testimony of William S. Lee, Pres Duke Power Co., NCUC Docket e-7 sub 314 re McGuire Nuclear Station, PWR, Unit 1, placed into commercial operation December 1981). Absent a detailed analysis such as described above, there is no reason to believe any experimental plant would outperform ordinary plants with experience. 60% is a reasonable upper bound for CRBR early performance.

As noted above, if TVA doesn't have \$11 billion to blow in 1996,

CRBR will never have any other performance. Look at the record of the early LWRs, many of which were shut down as uneconomical within a few years, and almost all of which have been retired in less than 20 years of operation. Admiral Rickover (testimony to Joint Economic Committee of Congress 1-28-82) stated that sodium reactors are trickier to handle than LWRs. He ought to know, having pioneered in development of all sorts of naval reactors, including breeders cooled by sodium. That means the likelihood of CRBR problems is greater than LWRs, and problems mean shutdowns.

WE-12

Clearly CRBR will be uneconomical to operate in the 1990s. The investment, in 1990 dollars, would be about \$7 billion. Assuming depreciation over 30 years, the requirement is over \$230 million per year. The output, realistically valued, gives a fuel savings of under \$11 million per year at 76.5% C.F. If we assume 60% C.F. (and keep 350 MWe net output, since additional investment will be required to get 379 MWe net), the fuel savings are only \$9 million per year, or a 4% ~~return~~ ^{1990 \$} of depreciation costs alone. This also assumes that CRBR operating expenses are as low as for TVA coal and nuclear units in the 1990s. This is unlikely, as breeders are more complex and require more maintenance and care in operation.

WE-13

Assuming a "fire sale" price of \$1 billion to TVA (1/7 the value of the plant) in 1990 dollars, the return on investment would be under 1% per year AT MOST. Is TVA that crazy? I hope not, and TVA's recent actions in cancelling nuclear units with substantial investment already made in them indicate TVA is capable of sound economic analysis, which would obviously reject the CRBR purchase even if it could be bought at 1/7 of its adjusted cost and if there were no

WE-13 inflation. 1% a year still wouldn't pay, because investments generally pay 2 to 3 percent above inflation. (SEE NRDC comments on Satsop nuclear DEIS, 1982; experience of Swiss banks over the centuries indicates a similar trend, with interest rates of about 2% when there was no inflation).

In sum, operating CRBR is economically forced to be a 5-year project with very little payoff even if CRBR works. For the additional \$1.5 billion to be invested, the US could import a French Super-Phoenix at a total cost of around \$6 billion (\$5000/KW) but it is clear that that technology is already uneconomical compared to LWR nuclear energy, which itself is uneconomical compared with cost-effective energy conservation investment throughout this century. (See, e.g. UCS, Energy Strategies, 1981; Lovins, Soft Energy Paths; and The Energy Controversy; and Lovins & Lovins' new book on energy security; Wilson ~~and~~ Clark, Energy, Vulnerability & War). David Stockman's 1977 memo on the uneconomics and the lack of need for CRBR remains an excellent statement of why CRBR should not be built. You can get a copy from Friends of the Earth, 530 7th St. SE, Washington DC. Simply put, no electricity technology costing \$5000/KW is competitive. The capital charges on such would be \$1000/KW-year at current rates of return for investor-owned utilities, which would be 16 cents per KWH even if 76.5% CF could be achieved. Remember, the conservation efficiency alternatives cost 3¢ and under. They can also be built faster and create more jobs. See SERI report "Building a Sustainable Future" 1981.

In sum, the entire justification of CRBR in the FES, unchanged in the DS.FES is the power production (shown above to be trivial and horrifyingly uneconomical on any assumptions. 100% capacity factor means you could get \$14 million in fuel savings from

a \$7 billion investment, or about 0.2% return.) and the following:

WE-13

"The principal benefit of the proposed facility would be to demonstrate the liquid metal fast breeder nuclear reactor concept for commercial use in generating electrical power. If the applicability can be demonstrated, the useable energy in our uranium resources would be extended and the country would become more self-sufficient in energy production." FES p10-7, see DS/FES p 10-9)

The first of these ideas is readily shown false. CRBR itself will be most uneconomical, but assume that a larger breeder would cost (in constant dollars) only 2/3 as much per KW (using 6/10 ~~xxxx~~ power "law" which is a rule of thumb on economies of scale in powerplant construction) for a plant twice the output. Is this a commercially viable ~~saving~~ saving? No. It drops the breeder cost from triple LWR cost per KW, to double. No fuel advantage can compensate for the large capital cost, and the cost of reprocessing fuel is shown by the need to invest \$500 to 700 million additional in the Barnwell Nuclear Fuel Plant to make it run "acceptably" safely and well. I.e. reprocessed plutonium fuel is likely to cost more than uranium, not less.

Nor are the economies of scale to be realized after CRBR immediately, for scaling up the plant to double size will require much more R&D on the first few plants. CRBR will not make breeders commercially viable.

US total energy use and imported energy is dropping as we increase our energy efficiency (DOE estimates of total primary energy consumption, 1977-81). Even nuclear engineers (e.g. Gyftopoulos, 1979) note that increasing efficiency in energy use accounts for most of the change in energy use. Since, as shown above, efficiency investments are much more cost-effective (minimum 5:1 advantage over CRBR and 3:1 over a "developed" larger breeder economy with no further rise

WE-13 in breeder cost per KW), there is no need to develop CRBR now.

Why pay 16¢ for power you can save for 3¢ or less (the 5:1 advantage)?

CRBR will ~~not~~ help convince the public that breeders are uneconomic

WE-14 (as the French are learning). The only reason to construct such an uneconomic nuclear facility would be to develop plutonium for weapons (e.g. South Africa, Israel, Argentina, Iran, Iraq etc). Developing CRBR in the USA where plans etc can be readily obtained and freely ~~xxx~~ copied and shipped, will simply transfer a dangerous technology to more nations who can make bombs with a "peaceful" front. Of course, plutonium can be diverted from CRBR. It is ~~xxxxxxxx~~ clear that the whole back end of the CRBR cycle is not developed, and there is no assurance it will be in the USA. If there are no more breeders (as seems economically likely), CRBR spent fuel can only be turned into CRBR fuel. That's terribly wasteful. And it will be a detriment to national and world security to publicize and develop CRBR technology which can make plutonium under a peaceful front. In sum, CRBR is a perk barrel pure and simple, of no economic use, of great danger in nuclear proliferation, and able to convince the public that nuclear breeders are lemons, not at all cost-effective.

III. Nuclear proliferation: see above on this page.

WE-15

IV. Alternate sites: It is clear (DS/FES pp 11-17)

that the Murphy Hill site is equivalent of superior to Clinch River in all areas but (as claimed) socioeconomics. Given that the coal gasification plant will not be built (uneconomic; budget cuts), additional farmland need not be taken for a breeder. Yet, population density is far less around Murphy Hill (L-1.2.6) and it does not raise the accident risk to basic nuclear facilities such as Oak Ridge Gaseous Diffusion Plant, ORNL, Y-12 (for bombs) etc as does Clinch River. The lesser labor pool near Murphy Hill

is hardly a compelling disadvantage of that site when its water WE-15
quality and dilution flow are superior to Clinch River. Moreover,
Murphy Hill radioactive emissions could be monitored better
since they would not flow into a river already contaminated
by ORk Ridge activities since 1942, which is the case at CRBR
on the Clinch River near White Oak Creek, which EPA has identified
as the most radioactive creek ~~on~~ in the Eastern part of the USA.

In sum, Murphy Hill is a better site if you insist on
building this ~~prank~~ pork barrel turkey to join Sen. Baker's
other monuments (e.g. Tellico Dam, a money-losing land-destroyer
with negative net benefits; Tennessee-Tombigbee "waterway" also
horribly uneconomical, and environmentally unsound). Murphy
Hill has less population, cleaner water (easier to monitor too)
and fewer facilities near it to be threatened by a CRBR accident.
So, change the name to MHBR, repeal Murphy's Law as it may
apply to Murphy Hill, and happy nucleating to you, if you insist
on wasting out long-suffering taxpayers' money on this mess.

A cynic might suggest that NRC would prefer the Clinch
River site to Murphy Hill because radioactive leaks at
Murphy Hill, and their effects on the environment, would be
easier to identify. I suggest that NRC should protect the
public health and safety by selecting Murphy Hill FOR the
reason of easier detection, as well as less ~~risk~~ people and
property at risk in an accident.


Wells Eddleman
Energy Consultant

UCS

Union of
**CONCERNED
SCIENTISTS**

13 September 1982

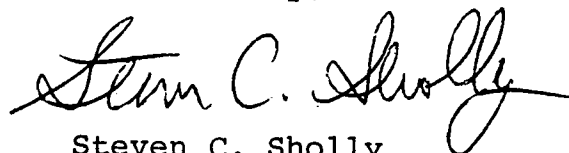
Mr. Paul Check, Director
CRBRP Program Office
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Check:

Enclosed are UCS's comments on NUREG-0139, Supplement No. 1, "Draft Supplement to Final Environmental Statement Related to Construction and Operation of Clinch River Breeder Reactor Plant". These comments are limited to matters arising from the NRC's analysis of accidents beyond the design basis of CRBRP.

Your attention to the matters raised herein is requested. I will be happy to discuss these comments with you or members of your staff if that will be useful.

Sincerely,



Steven C. Sholly
Technical Research Assistant

ENC: As stated

COMMENTS ON "DRAFT SUPPLEMENT TO FINAL ENVIRONMENTAL STATEMENT
RELATED TO CONSTRUCTION AND OPERATION OF CLINCH RIVER
BREEDER REACTOR PLANT, DOCKET NO. 50-537

Steven C. Sholly *(Signature)*
Union of Concerned Scientists
1346 Connecticut Avenue, N.W., Suite 1101
Washington, D.C. 20036
(202) 296-5600

September 13, 1982

The Union of Concerned Scientists hereby files the following comments on NUREG-0139, Supplement No. 1, Draft Report, "Draft Supplement to Final Environmental Statement Related to Construction and Operation of Clinch River Breeder Reactor Plant", Docket No. 50-537, July 1982. These comments are limited to the issue of the impacts on the environment and on public health and safety of accidents beyond the design basis of CRBRP.

A number of issues are raised by the Draft Report's treatment of the consequences of beyond design basis accidents, referred to in the report as "core disruptive accidents" or "CDA's". Each issue is delineated and discussed separately below.

Table J.1, Comparison of DBA's at CRBRP with LWR's

UCS-1

At pages J-1 and J-2 of the Draft Report, a comparison is drawn between the CRBRP and several pressurized-water reactors now under construction. It is unclear from both the text and Table J.1 whether the doses referred to are exclusion area boundary or low population zone doses; this is unimportant, however, as explained below.

UCS-1

The comparison of doses resulting from postulated fuel-handling accidents and an accident involving the so-called "site suitability source term" between CRBRP and the PWR's listed in Table J.1 is terribly fallacious on a number of counts. First, CRBRP is a very different type of reactor, a liquid-metal fast breeder reactor as opposed to the light-water cooled pressurized water reactors with which it is being compared (Commanche Peak, Callaway, and Palo Verde).

Second, the thermal power levels of these reactors are very different. Even if one uses the future potential rating of CRBRP at 1121 MWt, this scarcely compares with the thermal power output of the PWR's with which CRBRP is compared in Table J.1 (i.e., Commanche Peak and Callaway are Westinghouse PWR's with a rating of 3411 MWt, and the Palo Verde plants are Combustion Engineering PWR's with a rating of 3817 MWt). The PWR's with which CRBRP is compared have a thermal power output that is a factor of three higher than CRBRP; thus, the comparison of exclusion area or low population zone boundary doses given in Table J.1 is not a sound comparison. The comparison, if it should be made at all (which is questionable), should be based on LWR's with an equivalent thermal design rating.

Third, the source term for CRBRP will be different in some respects than the source term for a LWR of comparable thermal design rating. The source terms should be compared both in terms of the curie content of the cores at shutdown and in terms of the significance for health and contamination consequences of differences in inventory of specific radionuclides (e.g., Plutonium-239, which has an inventory at CRBRP which is a factor of five greater than the reference inventory for the WASH-1400 analysis, which was for a 3200 MWt PWR; WASH-1400, App. VI, pages 3-1 through 3-3).

Fourth, comparison of doses resulting from hypothetical design basis accidents is of little use in evaluating either environmental impact or societal or individual risk from CRBRP or any other plant. As noted on page J-2 of the Draft Report Supplement, engineered safety features will be provided to prevent such accidents and/or mitigate their consequences. Only if these engineered safety systems fail would the consequences from such accidents become of great public health concern, however, under such circumstances, the accident is beyond the design basis and should be analyzed as such.

Fifth, comparison of doses resulting from accidents within the design basis should be made at the same distance, not at whatever distance the exclusion area or low population zone happen to be for a particular plant compared with other plants.

Based upon the above considerations, UCS concludes that the comparison of doses resulting from accidents within the design basis as set forth in Table J.1 of the Draft Report Supplement is technically flawed and should be eliminated from the Final Report Supplement. If, on the other hand, the NRC persists in making such a comparison (which UCS believes would be a waste of time and of precious little use), the comparison should take full account of the factors discussed above in making such a comparison.

Probability "Estimates" Presented in the Draft Report

Probability "estimates" are made at a variety of places in the Draft Report Supplement. It is quite apparent that these numbers are very "soft" and are not based on any detailed analysis of the final design and operating procedures for CRBRP. Indeed, at this stage of the project, detailed

UCS-2 probability or frequency numbers would be generally expected to be unavailable. The uncertainties in the probability results presented in the Draft Report Supplement must be very large, certainly in excess of an order of magnitude.

UCS can discern little enough basis for confidence in probability or frequency estimates for more conventional light-water reactors (for which there is at least some base of experience). It is ludicrous, we believe, to assign a lower probability for system failures or unavailability for CRBRP systems than are calculated for LWR's, yet this is done in the Draft Report Supplement. A prime example is the 1:100 per demand failure rate given at page J-7 for containment isolation. A review of actual LWR experience conducted by American Nuclear Insurers concluded that the overall availability of containment integrity was about 0.85 (Michael B. Weinstein, "Primary Containment Leakage Integrity: Availability and Review of Failure Experience", Nuclear Safety, Vol. 21, No. 5, September-October 1980, page 629). Even if the value for PWR's is used as being applicable to CRBRP, it is still a factor of four greater than that assumed in the Draft Report Supplement (availability of containment leakage integrity is given as 0.96 for PWR's and 0.77 for BWR's in Weinstein's article). It should be noted that if the most serious CDA occurs with a breach in containment integrity, a very large release to the environment would occur.

The probability and failure estimates that are tossed around so lightly in the Draft Report Supplement must be placed into far better context. Certainly, there is little basis for the sort of comparison attempted in Table J.5. There are other problems with Table J.5; these are addressed immediately below.

Risk Comparisons Between CRBRP and LWR's

UCS-3

Table J.5 attempts to compare the "average values of environmental risks" of CRBRP with Midland. This comparison is technically indefensible on a number of grounds.

First, Table J.5 appears to ignore the well-known uncertainties in probability estimates. Accounting for such uncertainties, especially in the case of CRBRP, could alter the comparison attempted in Table J.5 considerably.

Second, comparison of "average values of environmental risk" is essentially meaningless. If the NRC believes its probability numbers (which UCS does not), a more meaningful comparison would have been to compare consequences resulting from releases at a variety of probability levels (such a comparison was made for alternate sites for the Perryman early site review; see SECY-78-137, 3/7/78, Enclosure D). Particularly important are peak consequences, which the Draft Report Supplement fails completely to address.

Third, the comparison should be made for plants with roughly the same thermal power level. As noted above, CRBRP may eventually attain a design thermal rating of 1121 MWt; the Midland reactors have a design thermal rating of 2452 MWt, more than a factor of two higher than CRBRP. In addition, as noted above, the source terms for the two reactors are likely to be different.

Fourth, the comparison should be extended to include long-term land contamination arising from beyond design basis accidents. Given the much higher inventory of certain long-lived fission products in CRBRP (e.g., Plutonium-239), it would appear that a potential exists for a severe accident at CRBRP to cause much longer duration contamination problems than would a severe accident at a conventional LWR. The environmental and public health impacts of such a difference cannot be dismissed without analysis.

UCS-3

Fifth, UCS notes that the assumed proportion of the most serious CDA is 1 in 10 per CDA (see page J-6 of the Draft Report Supplement). This factor, if essentially correct, argues persuasively for a detailed analysis of peak consequences.

Sixth, the basis for the release categories established in Table J.2 for CRBRP should be more rigorously established. UCS notes, for example, that even the most serious release category assumed for CRBRP dose not come close to the release categories in WASH-1400 for LWR's (e.g., PWR-2). The assumed release categories for CRBRP alone would explain the difference in risk, even assuming "average" values as done for Table J.5.

CRBRP Consequence Analysis

UCS-4

The consequence analysis for CRBRP was carried out using the COMO (a.k.a., CRAC) code developed for WASH-1400. The CRBRP analysis apparently utilized the standard meteorological sampling procedure typically used for COMO consequence analyses. A recent paper by Ritchie, Aldrich, and Blond casts substantial doubt on the adequacy of this meteorological sampling technique, and describes a more consistent and accurate methodology. The Ritchie, et. al., paper displays results for early fatalities which shows that using the WASH-1400 sampling technique, consequences can vary by about an order of magnitude, and probabilities can vary by about a factor of five. The proposed new sampling technique, dubbed "weather bin sampling", displays much smaller uncertainties. The CRBRP consequence analysis should be redone in accordance with weather bin sampling to assure that the consequence results are more representative of the historical weather conditions in the site area. It should be noted that this may change the results in either direction.

In addition, as suggested above, consequence results for a variety of consequences should be presented at a number of probability or frequency levels. Simply giving "average" results is potentially very misleading in terms of overall risk and does not provide a firm foundation for decision-making, especially when comparing the CRBRP proposed site with alternatives, as explained below.

One other matter should receive attention in re-calculating the consequences of CRBRP accidents. The relative contribution of different radionuclides to different health effects must be adequately addressed. For instance, the much higher inventory of Plutonium-239 poses a distinctly greater hazard for CRBRP than for the contentional LWR's previously analyzed using COMO (CRAC). In addition, the contribution of such radionuclides to long-term contamination must also be addressed.

Analysis of Alternate Sites

The analysis of alternate sites should be expanded to include an accident consequence analysis for each proposed alternate site. For example, judging from the 50-mile population figures for alternate DOE sites on page 9-11 of the Draft Report Supplement, the Clinch River site has the highest population, and INEL has the lowest (a factor of roughly six lower than Clinch River). Such a difference could reasonably be expected to result in a lower risk of latent consequences for INEL than for Clinch River. In addition, costs of severe accidents may be lower for INEL (this would have to be explored with site-specific data).

Such an analysis is not without precedence; as noted above, the Perryman early site review included a consequence analysis of alternate sites

UCS-5 (SECY-78-137, 3/7/78, Enclosure D). Given the unique circumstances here, such an analysis is all the more justified.

UCS notes that the above analysis is needed to choose the best available site, not just an acceptable one. There may be a number of sites that NRC finds acceptable, but it is the best site that should be chosen, especially for such a unique project with which experience in the U.S. is virtually none and with which experience worldwide is limited at best. UCS believes that if the CRBRP is to be built at all (a position which we do not support), the public should be provided with the most protection available in terms of the remoteness of the site.

SA

Sorghum Alliance
180 Market Street
Lexington, Kentucky 40507

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
Attention: Director, Clinch River Breeder Reactor Program Office

RE: Draft Supplement to the Final Environmental Statement on
Clinch River (NUREG-0139, Supplement No. 1)

The Sorghum Alliance would like to call attention to the following flaws in the Draft Supplement.

2 The section covering Transportation Accidents Involving
Radioactive Material is totally inadequate.

SA-1

The overall conclusion is "that transportation accidents involving radioactive material from CRBRP present a low risk of fatality or other serious health effects from radiation exposures." The support for this conclusion is invalid.

Shipments are to be made by rail. Because of the deterioration in railroad track beds, rail is not a safe means of transportation. Eighty percent of railway accidents are caused by broken rails which cause derailments, and the railway accident rate is rising.

Casks to carry irradiated fuel assemblies will "be built to current standards using proven technology." High level wastes are to be shipped in similar casks. "It is extremely unlikely that this cask could be breached even if involved in an accident." Unfortunately the first of my quotations contradicts the second. Current standards are ridiculously inadequate, as Marvin Resnikoff of the Council on Economic Priorities has shown. The standards require only that the casks withstand a 30' drop onto an unyielding surface, a 40" drop onto a cylindrical spike, a fire of 1475°F lasting one hour, and immersion under three feet of water for eight hours. These standards do not represent actual accident conditions. To take just one point, the average temperature of a fire is 1850°F, and there are at least 21 industrial materials routinely shipped in large quantities that burn at temperatures of over 2800°F. Furthermore, in most areas of the country fires cannot be extinguished in half an hour as a general rule, since 90% of U.S. firefighters are volunteers. These standards do not represent all types of accidents. For instance, a railway accident may involve crushing, as a cask may be pinned between rail cars. The technology which has gone into present day casks cannot be characterized as "proven." None of the casks currently in use has been physically tested. Tests have been conducted only by computer

SA-1

simulation or with scale models. Simplifying assumptions are used in the computer "tests." What testing of actual casks has been done has revealed problems. In a test of obsolete casks at Sandia Laboratories two out of three cask seals leaked or were damaged. Once unsealed, a valve is not likely to seat itself.

"Quality assurance" is given as a reason for safety. Actually quality assurance in constructing existing casks has been poor. For instance, the highway shipping casks NAC-1 and NFS-4 have shown design and construction flaws. welds are defective, apparently because the wrong metals were used.

The statement avoids analysing the contents of a cask containing spent fuel assemblies from the CRBR, but says that their radioactivity for 100 years is similar to that from the spent assemblies of light water reactors. This is not reassuring. In case of an accident, solids are likely to remain in the cask but gases will escape and, depending on whether fuel rods remain intact and on whether the temperature rises, volatiles may also escape. Radioactive gases which could be released from a light water reactor include iodine and krypton. The volatiles include cesium and tellurium. A release of 10% of the cesium in a truck cask (one quarter the weight of a railway cask) could, according to Resnikoff, cause hundreds to thousands of early deaths due to pulmonary edema among residents within a quarter mile of the accident, if the mishap occurred in an urban area. People further than one quarter of a mile away would be likely to die later of cancer, and an area of one half square mile would be rendered uninhabitable for over a hundred years. The statement assures us that the "probability of a significant radioactive release from spent fuel assemblies in transit is small." Any release of cesium could hardly be called insignificant.

The NRC needs to reassess the risks of transportation of radioactive materials from the CRBR in the light of facts, not wishful thinking. In doing so, the NRC needs to take into consideration and to answer the questions posed by Resnikoff's current work on transportation.

8. The Need for the Proposed Facility is not explained in the the final EIS on the CRBR or in its supplement

8.1
SA-2

We are referred to the LMFBR Program Final Environmental Impact statement and its supplement for a justification of the CRBR. I do not have a copy of these documents. However, a quotation from the supplement indicates that they do not present an adequate justification. We are told that the "consequences of early development . . . are minor compared to the risk of possible electrical shortages and economic penalties associated with late development. The quotation needs an explanation within the Supplemental EIS on Clinch River, as it flies in the face of facts.

Whether or not Clinch River and other LMFBR's are constructed, no electricity shortage will occur if the United States adopts a sound energy program based on conservation, on the development

of solar energy in its varied forms, and, while necessary, on the use of coal. Studies have shown this so frequently that citations should be unnecessary, but one example is the Energy Project of the Harvard Business School, which found that conservation could save 30-40% of our energy use and solar could produce 20% of the energy we consume by the year 2000. At the time that Clinch River was planned, the amount of energy being used in this country was increasing, but in 1980 and in 1981 it decreased. Wise utilities are cancelling the nuclear power plants for which LMFBR's were to breed fuel, because they know that electricity from these plants will not be needed. Last month TVA, which will operate Clinch River, cancelled four reactors. SA-2

Furthermore, the economic penalties lie with the construction of Clinch River, not with its cancellation. The current estimate of the cost is \$3.57 billion, and the expense could rise to over \$7 billion. Even if one considers that nuclear power is necessary, which we do not, there are better ways to spend this money. Dr. Henry D. Sokolski pointed out that improving the efficiency of uranium use at current reactors and finding safe, economical ways of storing spent fuel would be expenditures more helpful to the nuclear industry. Uranium now sells for approximately \$23 a pound. In November of 1981 the Department of Energy's own Energy Research Advisory Board reported that uranium may have to reach \$400 a pound before the breeding of the fuel at CRBR would be profitable.

The Department of Energy board made the statement in November that "The ERAB believes that the construction of a breeder reactor demonstration at this time is not an urgent priority and thus, under current budget constraints, recommends that such a demonstration be delayed until a future time." Such a statement should be acknowledged and answered within the supplemental EIS, as it is diametrically opposite to the quotation from the supplement to ERDA-1535.

Under the discussions of need for the CRBR in the EIS and supplement on the CRBR, there is not the slightest allusion to the question of whether the results expected are worth the risks of embarking on the use of plutonium, for risks there will be, even if the utmost caution is used. This is a glaring omission.

8.4.1

The supplemental statement adds nothing to the superficial section on Pool Type Reactors in the Final EIS, although it speaks of the good experience with breeders that we are gaining from current U.S. and foreign programs and praises the Phoenix and the PFR, both of which are pool type reactors. Dr. Sokolski has stated that the CRBR's loop design "is already six or more years behind the pool designs the French have built and when complete will be at least 16 years out of date." The supplemental EIS should incorporate the results of the past five years of breeder development and use and, based on this, should give a cogent defense of the chosen method. If we do have a CRER, it should be up to date. SA-3

8.4.4
SA-4

The Fast Flux Test Facility has been operating since 1981, according to the supplemental EIS, with success. The supplemental EIS should therefore consider in some detail why or why not the FFTF could be used for testing that is to be done at the CRBR. Surely the NRC knows more about this matter now than it did in 1977. The FFTF has the loop type of design currently planned for the CRBR.

M. B. Davis
Coordinator

DHHS

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Food and Drug Administration
Rockville MD 20857

SEP 13 1982

Mr. Paul Leech
Project Manager
Office of Nuclear Reactor Regulations
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Leech:

The Bureau of Radiological Health staff has reviewed the Draft Supplement to the Final Environmental Statement (FES) relating to the construction and operation of the Clinch River Breeder Reactor Plant (CRBRP), NUREG-0139, dated July 1982. We previously commented on or about November 1976 on the radiological safety aspects of the Draft Final Environmental Impact Statement. We note that the NRC reviewed and responded to our comments in Section 11. In response to this newer document, the Bureau staff has reevaluated the public health and safety impacts associated with proposed issuance of a construction permit and have the following comments to offer:

1. The presentation in Section 3.5, Radioactive Waste Systems, and Section 5.7, Radiological Impacts from Routine Operations, shows that there would be no significant changes in the impacts from those assessed in the FES. It appears that the proposed waste management system and proposed operations will maintain the radioactive materials in the effluents as low as reasonably achievable (ALARA). DHHS-1
2. The environmental exposure pathways discussed in Section 5.7.2 cover all possible emission pathways that could impact on the population in the environs of the facility. The dose models described in Regulatory Guide 1.109, Revision 1, used in the estimation of radiation doses to individuals and to populations within 80 km. of the plant, have provided the means to make reasonable estimates of the doses from normal operations. Results of the revised calculations are shown in Tables A 5.2, A 5.3 and A 5.5. The results confirm that the calculated doses are well within current radiation protection standards. DHHS-2
3. Discussions in Section 7 and Appendix J on the environmental impact of postulated accidents involving radioactive materials are considered to be an adequate assessment of the potential for radiation exposure of the population nearby, including the risk of near and long-term health effects of accidental contamination of the environment. DHHS-3

- DHHS-4 4. In view of the lessons learned from the Three Mile Island, Unit 2 accident, we suggest that Section 7 be expanded to include a statement that the CRBRP would have a Technical Operation Center (TOC) and an Emergency Operations Facility (EOF) constructed at the plant to provide emergency support and coordination needed to mitigate the consequences in the event of a nuclear accident. Since this is now a requirement for light water reactors, we believe it should also be a requirement for a breeder reactor as well. Also, it is not evident from this section what emergency preparedness measures have been instituted for the plant. In particular, what arrangements have been made with State and local authorities for coordination of emergency response efforts?
- DHHS-5 5. The modified radiological monitoring program, as presented in Section 6 and summarized in Table A 6.1, appears to provide adequate sampling frequencies in expected critical exposure pathways. However, the locations chosen for airborne particulates and radioiodine detection in sectors of highest wind frequency may not be sufficient to detect plant emissions under all potential release meteorological conditions. The analyses for specific radionuclides are considered sufficiently inclusive to (1) measure the extent of emissions from the plant, and (2) verify that such emissions meet applicable radiation protection standards.
- DHHS-6 6. Appendix D discusses the environmental effects of the CRBRP Fuel Cycle and transportation of radioactive materials. The radiological impacts as presented in Section D.2.4 cover all possible fuel cycle sources of radioactive material that could be released to the environment. The dose computational methodology and models used to estimate the population doses have provided reasonable estimates of the doses resulting from annual releases of radioactive effluents from routine operations of the CRBRP supporting fuel cycle. Results of these calculations, as presented in Table D.17 show that the collective dose to the total body would be about 170 person-rems, and that 140 person-rems of this collective dose would be from the fuel reprocessing plant. These impacts are considered to be as low as reasonable achievable.

Thank you for the opportunity to review and comment on this Draft Supplement to the Final Environmental Statement.

Sincerely yours,

John C. Villforth
Director
Bureau of Radiological Health

nuclear Subcommittee
National Energy Committee
854 Henley Place
Charlotte, NC 28207

SC



SIERRA CLUB 530 Bush Street San Francisco, California 94108 (415) 981-8634

U. S. Nuclear Energy Commission
Attention: Paul H. Leech
Clinch River Breeder Reactor Program
Washington, D. C. 20555

COMMENT, CRBRP DRAFT ENVIRONMENTAL STATEMENT--DECOMMISSIONING

The discussion of decommissioning in the Draft Environmental Statement, part 10.2.4, appears to be deficient in that it fails to recognize significant additional costs. SC-1

NRC regulations and guidance on decommissioning are now being revised. The cost estimates for SAFSTOR, ENTOMB, AND DECON are predicated on regulations and guidelines which have been in effect for some time. The history of regulations and guidelines has been that as more experience has been acquired and analyzed that exposure limits are lowered and guidelines made more rigorous. With the more stringent requirements that both reasonably and conservatively may be anticipated, not only in the immediate future, but over the period in which the CRBRP sees design and construction followed by a now indeterminate period of operation, the cost of decommissioning will increase. The DES fails to consider this probable course of events, just as the escalation in plant cost due to increasingly stringent regulatory standards was not foreseen at the time of the first cost estimate. SC-2

One regulation which should change is the permissible 5 microR/hr exposure at 1 meter. The gamma radiation of a large, uniformly radiating plane surface will be little affected by distance from the plane in the range 0 to 1 meter. But, for the irregularly shaped and nonuniform objects to be measured in plant decommissioning a more suitable conservative standard would be 5 microR/hr at a distance of 10 cm. Further, Co60, one of the significant sources, is a strong beta emitter, about 1.56 Mev before isomeric transition, 0.31 Mev after. Conservative radiation surveillance will take cognizance of beta which, of course, is undetectable at 1 meter. SC-3

There is uncertainty as to what the source terms will be at the end of operation of a plant not yet built. It is proper that the DES speak of a safe storage period of as long as 150 years. However there is no assurance that, depending on higher source terms and revised radiation limits, the period will not be 250 or 500 years. Maintenance and surveillance costs would increase accordingly. SC-4

There is a serious omission from both Applicant's and NRC's cost tables A10.3 and A10.4. Consideration stops at the year 1995. Apparently decommissioning costs are not considered. Nor does it appear that the costs of transport or disposal have been considered. For high level residues particularly the cost

of disposal is uncertain--no facility exists. Indeed the enabling legislation has yet to be passed.

SC-5

The disposal of the radioactive sodium primary coolant appears to have not been treated in sufficient depth. One scenario is that this sodium will be "saved" for another use. A conservative treatment requires coming to grips with the disposal of the sodium. An adequate treatment of this matter would require quantitative information of the composition of the radioactive constituents of the Fermi sodium and the change in composition in the period of use in the CR reactor. Nor has a pilot process for either disposing of or decontaminating the sodium been demonstrated and costed out. The estimate given of "about \$1.25 million in 1978 dollars" of "handling the sodium" appears to be without substantive basis. Nor is "handling" satisfactorily, i.e. meaningfully, defined.

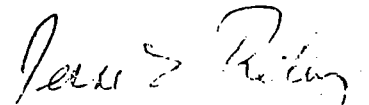
SC-6

The DES assumes that the secondary sodium does not become contaminated. This is a nonconservative assumption, especially in view of the widespread leakage due to a variety of causes, including mechanical, in PWR's, of heat exchanger tubes.

SC-7

No consideration has been given to the possibility of an accident cleanup in a malfunction, as at Fermi, as the immediate cause for decommissioning. A spontaneous autocatalytic disassembly would greatly escalate the cost of decommissioning, as the accident at TMI, where the cost of the cleanup of unit 2 exceeds the cost of construction, has shown. A Russian LMFBR exploded due to a leak between the secondary sodium and water systems. A provision for cleanup in the event of an accident, perhaps in the form of an insurance premium, should be included as well as the probable costs of coverage under Price-Anderson.

Sincerely,



Jesse L. Riley, Chair
Sierra Club Nuclear Energy
Subcommittee

Natural Resources Defense Council, Inc.

NRDC

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September 13, 1982

Mr. Cecil O. Thomas
Acting Director
Clinch River Breeder Reactor
Program Office
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Re: Draft Supplement to Final Environmental Statement
related to construction and operation of Clinch River
Breeder Reactor Plant, NUREG-0139, Supplement No. 1
Draft Report (July 1982)

Dear Mr. Thomas:

Enclosed are the comments of the Natural Resources
Defense Council, Inc., on the above-referenced draft supplement
to the CRBR final environmental statement.

Sincerely,

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NRDC COMMENTS ON THE DRAFT SUPPLEMENT TO THE
FINAL ENVIRONMENTAL STATEMENT RELATED TO
CONSTRUCTION AND OPERATION OF THE
CLINCH RIVER BREEDER REACTOR PLANT (NUREG-0139,
SUPPLEMENT NO. 1 DRAFT REPORT, DOCKET NO. 50-537)

NRDC-1 SECTION 1.3, Status of the Project

The last two paragraphs on page 1-1 should be updated to reflect the current licensing status of the CRBRP. The last paragraph on page 1-1 should be updated to reflect the latest schedule for CRBR construction, reactor criticality, and demonstration. The Staff should discuss whether this schedule is consistent with recent experience with schedule slippages for the construction and operation of commercial power reactors.

NRDC-2 SECTION 2.1, The Site and Environs, General Description

In the second full paragraph on page 2-1, the possible construction on the Oak Ridge Reservation of the Tennessee Synfuels Associates Coal-to-Gasoline Facility should be included. The Staff should discuss the potential effects on the CRBR and on the environment of construction of the nearby synfuels plant. In particular, the Staff should discuss the impact of an accident at one plant upon operations at the other plant, and should discuss the synergistic effect of carcinogenic emissions from the synfuels plant and radioactive emissions from the CRBRP. The Staff should also indicate that

DOE proposes to construct a developmental reprocessing plant (DRP) two miles east of the Clinch River site (inside the LPZ) in order to reprocess fuel from the CRBRP. The Staff should discuss the implications of this plant for the siting of the CRBR.

NRDC-3

In the final paragraph on page 2-1, the Staff mentions that "[w]ithin a 20-mile radius of the site, 12 public water systems and 15 industrial systems draw from surface water, including the Clinch River and the Emory River." The Staff should consider and discuss how CRBRP radioactive discharges into the Clinch River might affect the portion of the public that uses the Clinch River for its drinking water.

NRDC-4

SECTION 2.5.1, Hydrology, Surface Water

NRDC-5

The Staff states on page 2-5 that flow reversal of the Clinch River would occur as a result of the abrupt shutdown of Melton Hill and Watts Bar Dams and by the release of water from Fort Loudon and Tellico Dams. The Staff also states that there may be periods of zero flow of the Clinch River because of regulation at the Melton Hill Dam. The Staff should discuss the effects of Clinch River flow reversal or periods of zero release upon the liquid pathway dose calculation in Sections 5 and 7.

SECTION 2.5.3, Floodplain Effects

NRDC-6

There are three areas in this section that are inadequately addressed, according to Executive Order 11988 and DOE Regulations, Compliance with Floodplain/Wetlands Environmental Review Requirements (10 CFR Part 1022).

A) Alternatives

This section is totally inadequate in its listing or discussion of alternatives to the existing proposal, although this is a requirement appearing throughout the regulations. 10 CFR §1022.3 says:

DOE shall exercise leadership and take action to: (a) Avoid to the extent possible the long- and short-term adverse impacts associated with the destruction of wetlands and the occupancy and modifications of floodplains and wetlands, and avoid direct and indirect support of floodplain and wetlands development wherever there is a practicable alternative.

* * *

(d) Identify, evaluate and as appropriate implement alternative actions which may avoid or mitigate adverse floodplain/wetlands impacts.

The consideration of alternatives to construction in a floodplain or wetlands is a significant requirement in complying with these regulations. It is specifically referred to in Executive Order 11988 and in the definitions of an Environmental Assessment and a Statement of Findings. The procedures within the regulations (§1022.12(a)(3)) outline that a floodplain/wetlands assessment shall include:

NRDC-6

Alternatives. Alternatives to the proposed action which may avoid adverse effects and incompatible development in the floodplain/wetlands shall be considered, including alternate sites, actions, and no action. Measures that mitigate the adverse effects of actions in a floodplain or wetlands, including but not limited to minimum grading requirements, runoff controls, design and construction constraints, and the protection of ecology-sensitive areas shall be addressed.

The only mention of this vital issue in the section of the DES dealing with floodplain effects can be found in paragraph 5 which states:

Construction of the plant would neither increase runoff to nor constrict flow in the Clinch River significantly. None of the plant features located in the floodplain would increase floodflows or change the flood level measurably. Furthermore, there do not appear to be reasonable alternatives to these features which, by necessity, must be located adjacent to or in the Clinch River.

There is no discussion about what alternatives, if any, were considered and why they were rejected in favor of this proposal. What is meant by "not constrict flow. . . significantly" and not "change the flood level measurably"? Would other methods create less environmental impact? There is no way adequately to assess the methodology DOE used or to determine whether in fact this requirement was fulfilled.

The Staff should discuss in detail the extent of any harm to floodplains or wetlands from the proposed project; the cost of any alternatives; the additional environmental impacts, if

NRDC-6 any, caused by those alternatives; and the costs and benefits of all practicable mitigation measures. The Staff should, in particular, discuss whether CRBR construction at another site would result in less damage to floodplains or wetlands.

It becomes particularly difficult to understand why alternatives were not listed (much less discussed) in the DES since a Public Notice issued by TVA in cooperation with DOE (published in The Oak Ridger, Oak Ridge, Tenn. on August 31, 1982) at least contains a list of some alternatives that were considered:

Alternative onsite rail and road routes that would avoid wetlands or floodplains would pass through adjacent steep hills and require extensive ground excavations at excessive cost, resulting in additional environmental impacts.

The DES is sadly lacking in any discussion of what alternatives, if any, were explored, as required by Executive Order 11988.

B) Statement of Applicability to State and Local Standards

The DOE floodplain regulations (§1022.25(b)(4)) state:

For actions which will be located in a floodplain, DOE will publish a brief statement of findings which shall contain; . . . a statement indicating whether the action conforms to applicable state or local floodplain protection standards.

It is impossible to address the impact this activity will have on compliance with these standards, given that this issue was totally ignored in this section of the DES.

c) Critical Action Floodplain

The DES also fails to adequately address whether any of the proposed construction or operation activities would constitute a "critical area" (any activity for which even a slight chance of flooding would be too great; such actions may include the storage of highly volatile, toxic, or water-reactive materials). The Project Description section of the DOE floodplain regulations (§1022.12(a)(1)) states:

For actions located in a floodplain, the high hazard areas shall be delineated and the nature and extent of the potential hazard shall be discussed.

Pursuant to that, the regulations define two separate floodplains. The base floodplain is defined as the 100-year (1.0 percent chance of occurrence in any year) floodplain. The critical action floodplain is defined as the 500-year (0.2 percent) floodplain. The first paragraph of this section of the DES states:

The base floodplain for the purposes of this study is defined as the lowland and relatively flat area adjoining the Clinch River that is subject to a 1% or greater chance of flooding in any given year.

In other words, the Staff has determined that a base floodplain is sufficient for this study without any discussion, as required, on the potential hazards of locating portions of this project within the critical action floodplain. The maps included as part of the floodplain/wetlands assessment only indicate the 1 percent chance flood elevation. Therefore, this

NRDC-6 section only addresses plant features located in the 100-year floodplain such as treatment ponds, river intake and pumphouse, barge ramp, the intake and discharge structure, the plant access road, and railspur. The DES doesn't address whether any hazardous parts of the plant are going to be located above the 1 percent elevation floodplain but still within the 0.2 percent floodplain. Other activities and components of the Clinch River Breeder Reactor Project should be specifically addressed according to their location in the floodplain and potential hazards.

The only mention of this issue is the closing paragraph (7) which says:

Additionally, safety-related components of the plant are designed to withstand the effects of the probable maximum flood (PMF), a flood considerably more severe than that addressed by the Executive Order.

This in no way fulfills the nature or spirit of the abovementioned regulations.

In addition, in Figure A2.3 on page 2-8, the Staff shows the location of the proposed CRBRP barge unloading facility in the 100-year floodplain. The location of the proposed barge unloading facility is different than shown in Figure 3.3 of the 1977 FES. The Staff should resolve this discrepancy and explain the reason for any change in location, if such a change has been made. Furthermore, the Staff should identify the location of the proposed barge unloading facility to the

nearest tenth of a river mile, for purposes of identifying the amount of radioactivity in the river sediment at that location.

NRDC-7

Finally, the Staff should explain why rail shipment does not represent a "clear alternative" to the barge port and consequently why barging should not be avoided.

NRDC-8

SECTION 2.6, Meteorology

NRDC-9

In the third paragraph of this section, the Staff notes that "heavy fog may occur more than 34 days annually, since the proposed site is nearer the river than the weather office location." The Staff should indicate approximately how many days it would expect to find heavy fog at the proposed plant site, and should discuss the potential effect of heavy fog, including effects upon radiological dose assessments. The Staff should also include the latest meteorological data for the Clinch River site, rather than relying exclusively upon data collected from February 17, 1977 to February 17, 1978.

SECTION 2.7.1.1, Flora

NRDC-10

This section identifies two plant species known to be on the CRBRP proposed site that may at some time in the future be listed as threatened and endangered, according to the U.S. Fish and Wildlife Service (FWS). The Staff should describe all efforts made by the Applicants to avoid adverse effects to these two plant species, as requested by the FWS. In addition,

NRDC-10 the Staff should discuss the effect upon these plant species of the proposed 50% increase in land clearance.

SECTION 2.7.1.2.1, Mammals

The DES contains no discussion of any potential effects of CRBRP construction and operation upon bobcats, which have been observed several times in the Oak Ridge reservation. Such a discussion must be included. The Staff must also explain the basis for its conclusion that construction and operation of the CRBRP would not result in any significant deterioration of potential feeding habitat along the Clinch River for the grey bat, a threatened species.

The NRC Assessment of the Impacts of Clinch River Breeder Reactor Plant on Threatened or Endangered Species (August 1982) (the "NRC Biological Assessment") discusses the effects of CRBR construction and operation upon the endangered grey bat. This discussion should be incorporated into the DES, although it also contains several inadequacies. For example, Section 5.1 of the NRC Biological Assessment notes that there is evidence of a previous occupation of 500-100 (presumably 1,000) grey bats in a cave located in the northern portion of the CRBR site along Chestnut Ridge. The NRC states that the formerly occupied cave will not be affected by any construction or operational activities, and, therefore, would be available for reoccupation. It is not clear from this discussion whether the

site will be available for occupation at any time during construction or operation, or only after construction and operation are complete. If the latter, the NRC does not indicate whether loss of the use of the cave at this CRBR site for any period of time would hinder grey bat migration from summer to winter caves.

NRDC-10

The NRC Biological Assessment also claims that CRBRP construction and operation will not affect foraging habits of the grey bat in the vicinity of the site, since there will be a 25-foot wide vegetation border along the river. The Staff makes no mention, however, of whether human presence, noise, or other construction impacts that will occur late into the evening (at times, around the clock), regardless of any vegetation border, will affect the use of the river by the grey bat for foraging. Given this potential for disruption, the discussion of impacts upon the grey bat in the biological assessment is insufficient.

SECTION 2.7.1.2.2, Birds

NRDC-11

This section notes that five species of threatened or endangered birds have been observed on the CRBR site, including the bald eagle and four birds on the State of Tennessee threatened or endangered species list. Nowhere in the DES, however, does the Staff discuss the effects of plant construction and operation on these species. In particular,

NRDC-11 there is no analysis of the significance of the disruption to these species' activities from excavating, blasting, digging, clearing, or burning. Nor is there any discussion of the impacts of site clearing for the CRBRP, support facilities, roads, railroads, and transmission lines. The Staff states that no nesting activities of these species has been observed on the CRBRP site, but does not explain whether a literature search has indicated that nesting may occur at this particular site. Nor does the Staff indicate the methods for and extent of the search for nesting activities of these endangered or threatened species at the CRBRP site. There is no indication in the DES that the Applicants or the Staff have conducted the required biological assessment to determine the effects of the CRBRP on these listed and proposed endangered and threatened species.

NRDC-12 SECTION 2.7.2 Aquatic Ecology

This section notes that the U.S. Fish and Wildlife Service has notified the NRC that 11 species of freshwater mussels from the family Unionidae may be present at the proposed CRBR site or vicinity. The Staff relies on a freshwater mussel survey performed by TVA, one of the applicants, for its conclusion that only one of these species, Lampsilis orbiculata orbiculata, may be present. An analysis of the TVA's freshwater mussel survey and the NRC's Biological Assessment

reveals that, contrary to NRC's assertion, four other species NRDC-12
of endangered mussels may also be present.

First, the sampling techniques employed by the TVA scuba divers did not permit an adequate sampling of the dromedary pearly mussel, Dromus dromas. This species is particularly noted for its tendency to burrow beneath the substrate and in fact is almost never found on the surface. Yet the scuba divers, who apparently were not trained or experienced in the collection of mollusks, were not instructed to search for mussels below the substrate. The divers only looked and felt for mussels on the surface of the river bed and, as a consequence, could easily have overlooked specimens of Dromus dromas or other burrowing mollusks. The possibility that such species were overlooked is increased by the fact that almost 50% of the Clinch River substrate is of gravel, sand, or cobble, which could easily hide these species. Since Dromus dromas was known from the Clinch River prior to the construction of the Tennessee Reservoir system and has a current range which includes portions of the Clinch River, Tennessee River, and Powell River, the Staff should assume that this species is present at the Clinch River site unless an appropriate survey program demonstrates otherwise.

Second, the fact that a specimen from the species Fusconaia was collected just downstream of the proposed CRBR site in 1978 is sufficient evidence to indicate possible presence of both

NRDC-12 Fusconaia cuneolus and Fusconaia edgariana at the Clinch River site. The failure of the TVA survey to collect and/or identify any Fusconaia specimens is not conclusive evidence that they are not present. As mentioned above, these burrowing species may have escaped the notice of the divers, who did not conduct a prudent examination of the substrate. Also, no taxonomist was present during the survey and the samples were all returned to the Clinch River after identification by a non-taxonomist, making verification impossible. Given the difficulties of species identification for endangered mussels (the NRC Biological Assessment describes one instance of incorrect classification on pp. 17-18), it is very possible that this or other mussel species were collected but misclassified by the TVA.

Third, the rarity of this endangered species, which is neither dense nor widespread, should indicate in itself that failure to collect any specimens in one instance does not mean that such species are not present. This proposition is amply demonstrated by the NRC Biological Assessment itself. Since a specimen of Lampsilis orbiculata orbiculata was found in the Clinch River in April 1982 (and presumably returned to the river as an endangered species), why weren't that or other specimens collected in May 1982? Certainly the failure to collect L.o. orbiculata in May 1982 should not lead to a conclusion that the species is not present, given evidence of

its recent presence. Similarly, the fact that Fusconaia was collected in 1978 right near the proposed site should be sufficient for the prudent conclusion that this species is likely to be present now in that vicinity.

NRDC-12

Finally, the weight of the evidence indicates that the rough pigtoe pearly mussel, Pleurobema plenum, is probably also present in the vicinity of the CRBR site. This species was in fact known to inhabit the Clinch River within 40 river miles of the CRBR site prior to construction of the Tennessee Reservoir system (recorded by Ortmann in 1918 under the name Pleurobema obliquum cordatum). It has also been recently collected both upstream (in Kyles Ford, above the Norris Reservoir) and downstream (near the Wilson Dam, in Mussel Shoals) from the proposed site. There is no reason to believe, given this recent evidence and the inadequacies of the TVA freshwater mussel survey, that Pleurobema plenum is not still present in the CRBR site vicinity.

NRDC-13 SECTION 3.2, Reactor and Steam Electric System

On page 3-1, the Staff states that the Applicants expect to achieve a breeding ratio of 1.29 to 1 with the initial core and 1.24 to 1 with the equilibrium core. What is meant by the "to 1"? Is the Staff suggesting that the breeding ratio may be closer to 1 than to 1.24 or 1.29? The DES does not explain whether the Staff believes a ratio of 1.29 for equilibrium case is achievable or reasonable, nor does it explain the uncertainties existing in this breeding ratio for the initial core and equilibrium core. Quantification of such uncertainties in the breeding ratio calculations are necessary in order to enable the public to determine the likelihood that the plant will, in effect, achieve its breeding objectives. It is unclear from this description whether the breeding ratio indicated depends upon the availability of low plutonium-240 fuel. The DES should make this assumption clear. In particular, the DES should indicate whether the breeding ratio will change if recycled mixed oxide fuel is used to fuel the reactor.

NRDC-14 SECTION 3.3, Water Requirements

The Staff states that the anticipated annual average water makeup requirement and the estimated total consumptive use of river water have increased. There is no explanation of why such increases have occurred, or the effects of such an increase upon the environmental impacts stated in the 1977 FES.

SECTION 3.4.1, Heat Dissipation Cooling System

NRDC-15

The Staff states that a large increase has occurred in the cooling water flow rate to the CRBR cooling towers and in the heat rejection from each cooling tower. There is no discussion of the potential impact of this increased heat and moisture upon the existing and proposed roads in the site vicinity; for example, whether increased ice on roads in the winter will occur. There is also no discussion of whether the present heat rejection system will increase the number of days of heavy fog in the area and what impacts this increased fog might have upon the environment and local residents, including commuter traffic to CRBR and nearby industrial facilities.

SECTION 3.5, Radioactive Waste System

NRDC-16

In the 1977 FES, the Staff stated its belief that the design objective levels of 10 CFR 50, Appendix I should be considered in determining whether CRBRP radioactive releases would be "as low as reasonably achievable." It is unclear from the DES whether the Staff still holds this belief. In any case, given that there are significant differences in the radioactive effluent processing systems between LMFBRs and light water reactors, NRDC does not believe that unmodified use of Appendix I for the Clinch River Breeder Reactor is appropriate. The more appropriate method for determining whether CRBRP radioactive releases would be as low as

NRDC-16 reasonably achievable is to examine each CRBR system on a case-by-case basis. In any event, the Staff does not appear to have applied Appendix I, Section II.D. in judging the adequacy of proposed CRBR radioactive effluent processing systems. This should be done in the FES Supplement.

NRDC-17 The first sentence in Section 3.5 states that the PWR-GALE code was modified to apply to liquid metal fast breeder reactors. This section must be expanded to discuss how this PWR-GALE code was modified, and give the reasons for such modifications. This explanation is necessary to enable the reader to determine whether or not the impacts on the CRBR are indeed comparable to those from a light water reactor.

NRDC-18 The first paragraph in Section 3.5 states that the principal parameters used in the source term calculations are given in FES Table 3.2. The last two lines of Table 3.2 list decontamination factors for several elements in the Intermediate Activity System (IAS) and Low Activity System (LAS). This table is inadequate because it does not explain the basis for the decontamination factors used; in particular, the calculations used to derive such figures and the experience with other systems upon which factors were based. This table and Section 3.5.1 discuss systems used to washdown sodium-contaminated equipment in the IAS and LAS and are based upon an estimate of 0.5% fuel cladding defects. Neither Table 3.2 nor Section 3.5.1 contain any discussion of the activity

NRDC-18

level the Staff expects to see in either the IAS or LAS. Furthermore, there is no discussion of how these activity levels relate to the estimate of 0.5 percent fuel cladding failure, nor is there any indication of what the estimated activity level would be given a different fuel cladding failure estimate. There is no discussion in either the Table or Section 3.5.1 of the basis for the Staff's estimates of 0.5% fuel cladding failure or the basis for Staff's assurance, if any, that this percentage will not be exceeded.

SECTION 3.5.1.3, Balance of Plant Releases

NRDC-19

In the 1977 FES the Applicants estimated that the plant would release approximately 330 Ci/yr of tritium. The Staff said in the 1977 FES that this estimate appears reasonable and agreed with it. In the 1982 DES, the Applicants now estimate the tritium release to be approximately 2.3 Ci/yr, which is about two orders of magnitude less than their previous estimate. The Staff again states that this estimate appears reasonable and agrees with it. The Staff gives no indication for this drastic reduction in estimated tritium releases, or its reasons for agreeing with this changed estimate. Without a detailed explanation of the reason for such change, and the basis for Staff's endorsement of this change, it appears that the Staff is merely rubber-stamping whatever the Applicants propose.

NRDC-20 SECTION 3.5.1.4, Liquid Waste Summary

In this section, the Staff presents its evaluation of the proposed radioactive liquid waste treatment systems, and calculated the release of radioactive materials in the liquid waste effluent as approximately 0.016 Ci/yr, excluding tritium and dissolved gases. This estimate is exactly the same as that presented in the 1977 FEs. The Staff also presents the Applicants' estimate of radioactive materials in the liquid waste effluent, which has risen from 6.1×10^{-5} Cr/yr to 8.7×10^{-4} Cr/yr, excluding tritium and dissolved gases. There are a number of problems with this very brief section. First, it is impossible to determine how the Staff reached its estimate of 0.016 Cr/yr. The Staff merely states that its estimate is based on the use of different values than used by the Applicants for assumed defective fuel, plant capacity factor, the volume of waste released from the IAS, the quantity of radioactive sodium waste input to the LAS, the decay time prior to collection in the LAS, and the evaporator decontamination factor for iodine. It is imperative that the Staff identify and discuss what these values are, how they differ from those used by the Applicants, and why those different values were used. The final FES should also explain how these assumptions led to the Staff's final result.

Second, the Staff gives no reason why the Applicants' radioactive liquid waste effluent calculations have increased

from those given in the FES. It is important to explain the reasons for this increase, and to explain whether the Staff has also recalculated its estimates of liquid waste effluent radioactivity based on the reasons given by the Applicants, or merely repeated the figure given in the 1977 estimate. NRDC-20

SECTION 3.5.2, Gaseous Waste

NRDC-21

The main problem with this section, as NRDC has explained previously, is that the Staff is attempting to rely upon dose limits in 10 CFR, Part 50, Appendix I, for its conclusions that gaseous releases from the plant will be as low as reasonably achievable (ALARA). The use of these dose limits is inappropriate in the case of the Clinch River Breeder Reactor, because the cost of additional radioactivity control equipment appears to be less (in some cases, substantially less) for the CRBR than for light water reactors.

The Staff states that several changes have occurred in the design of the CRBR that, according to the Applicants, would result in a much greater release of radioactivity to the environment from gaseous waste. The Applicants now estimate a total release of 700 Ci/yr. for noble gases, as opposed to the 1977 estimate of 6.4 Ci/yr. This estimate of 700 Ci/yr is almost double that estimated by the Staff, even though it appears from the DES that the Staff has used more conservative assumptions regarding release of the RAPS noble gas storage tank inventory to the environment. The Staff must not only

NRDC-21 explain the reason for such a wide discrepancy in estimates between the Staff and the Applicants, but must also analyze each of the proposed processing systems, the costs of such systems, and whether such systems reduce radioactivity to a level that is as low as reasonably achievable. This analysis is particularly important since it appears that the Applicants have removed from the design several features that were originally proposed to substantially reduce radioactivity levels. For example, the Applicants no longer propose to bottle the noble gases. In another example, the Applicants no longer propose that the cell atmosphere processing system (CAPS) collect and process any leakage of gases in the nitrogen or air atmosphere cells housing the RAPS and CAPS components.

NRDC-22 SECTION 3.5.2.6, Gaseous Waste Summary

In this section, the Staff states that it uses a different parameter for defective fuel and increases the tritium release by a factor of 10 "for the reasons stated in FES Section 3.5.1.4." As noted above, Section 3.5.1.4 merely states that the Staff uses different values for factors such as defective fuel. The Staff must state what those values are and give the reasons for the differences in values between the Applicants and the Staff.

NRDC-23 SECTION 3.5.3, Solid Waste

This section needs to be expanded to include an explanation of why the estimates of the amount of radioactivity (Ci amount)

that will be contained in the solid waste from the plant have increased. The Staff must compare these radioactivity levels from solid waste, with the range of radioactivity levels present in solid waste from operating commercial plants, and explain the conclusion that these amounts are as low as reasonably achievable. NRDC-23

SECTION 3.5.3.1, Solid Waste Summary

NRDC-24

The Staff concludes that the proposed solid waste system is acceptable, but the proposal states merely that the waste would be packaged and shipped to a licensed burial site or stored on-site. It is unclear how long the waste would be stored on site; whether such storage would be temporary or permanent; the criteria that DOE would use in determining whether or not to store the waste on site, or in a licensed burial site; and whether or not these wastes would, in fact, be stored by DOE at Oak Ridge Reservation rather than at a licensed burial site. The Staff must include a discussion of these questions in Section 3.5.3.1.

NRDC-25 SECTIONS 3.6, Chemical Effluents; 3.7, Sanitary and Other Waste
4.4.2, Aquatic Impacts; and 5.4, Other Nonradiological Effects

The following comments on these sections are presented together since they all relate to the adequacy of the standards and requirements in the draft NPDES permit set out in Appendix H.

Our principal water quality concern regarding the draft NPDES permit issued by EPA is that it fails to comply with the provisions of Section 301(b)(1)(C) of the Clean Water Act, which states:

In order to carry out the objectives of this Act there shall be achieved not later than July 1, 1977 any more stringent (effluent) limitation, including those necessary to meet water quality standards . . . established pursuant to any State law or regulations . . .

EPA verifies that Tennessee Water Quality Standards are applicable to this permit. "NPDES Permit Rationale, Clinch River Breeder Plant, Permit No. TN0028801," dated June 24, 1982, at Part 1.B. However, Part II of the Permit Rationale, which states the basis of the effluent limitations contained in the permit, makes no mention of those standards. Repeated references are made to federal technology-based effluent guidelines as the grounds for effluent limits contained in the permit. But it appears that none of the limits were based on consideration of state water quality standards, despite the fact that the section of the Clinch River into which the project will discharge apparently is water quality limited for at least one toxic pollutant generated by the facility, according to data provided

in the DES on the proposed facility. We believe issuance of the NRDC-25 permit in its present form would violate the Act and 40 CFR §122.52(a) and (d).

A. Tennessee Regulations

Table A3.2 (page 3-15) of the DES entitled "Preliminary Estimates of Effluent Water Concentrations, indicates that the mean background concentration of copper is 36 ug/l and the maximum background concentration is 170 ug/l. These concentrations appear to exceed the allowable levels for Tennessee streams, such as the Clinch River, that are classified for uses including "propagation and maintenance of fish and other desirable aquatic life." (Chapter 1200-4 of the Rules and Regulations of Tennessee, Rule 3, Section (2)(a): General Water Quality Criteria for the Definition and Control of Pollution in the Waters of Tennessee.

Moreover, Section (3)(c) of the Tennessee Water Quality Criteria cited above sets forth the allowable concentrations of various pollutants in streams classified Fish and Aquatic Life. Section (3)(c)(7) states that in such waters:

There shall be no substances added whether alone or in combination with other substances that will adversely affect fish or aquatic life. The instream concentrations of toxic pollutants shall not exceed 1/10 of the 96-hour LC₅₀ based upon available data using one or more of the most sensitive organisms significant to the aquatic community . . ."

Furthermore, Section (4)(b)(ii) of the regulations, which deals with mixing zones for pollutant dispersement, states that

NRDC-25 such zones "shall not contain materials . . . in concentrations that exceed the 96-hour LC50 for biota significant to the aquatic community in the receiving waters."

The regulations also state that references to be used in determining toxicity limitations shall include Water Quality Criteria published by the U.S. Environmental Protection Agency pursuant to Section 304(a) of the Clean Water Act. Data contained in the document Ambient Water Quality Criteria for Copper (EPA 440/5-80-036, October 1980) indicate that the levels of copper found in the Clinch River do indeed exceed the limitations on toxicity listed above.

B. Conditions in Clinch River and CRBR Effluent

Table 1, entitled Acute Values for Copper, found on pages B-16 to B-28 of the copper criteria document (cited above), lists the results of toxicity tests examining the effects of a range of concentrations of copper on a variety of organisms. This table lists toxicity data for several species which, according to Section 2.7.1 of the DES (pp. 2-11 to 2-19), are significant members of the community of organisms found in the Clinch River at the point where wastewater from the breeder reactor would be discharged. These are cladocerans (Daphnia magna and Daphnia pullcaria), carp (Cyprinus carpio), bluntnose minnow (Pimephales notatus), striped bass (Morone saxatilis), bluegill (Lepomis macrochirus), and largemouth bass (Micropterus salmoides). The following table summarizes the data for these species.

<u>Species</u>	<u>Number of Studies</u>	<u>Copper Toxicity</u>	
		<u>LC₅₀--Range (ug/l)</u>	<u>LC₅₀--Arithmetic Mean (ug/l)</u>
<u>Daphnia magna</u>	11	9.8--200	53.6
<u>Daphnia pulicaria</u>	8	7.2--27.3	14.5
<u>Cyprinus carpio</u>	2	800--810	805
<u>Pimephales notatus</u>	9	210-340	236
<u>Morone saxatilis</u>	6	50-4300	1478
<u>Lepomis macrochirus</u>	7	660--10,200	4844
<u>Micropterus salmoides</u>	1	6790	6790

Comparing these data with the background concentrations of copper in the Clinch River, it appears that the mean concentration (36 ug/l) exceeds the mean LC₅₀ for one species, Daphnia pulicaria, and that the maximum concentration (170 ug/l) exceeds the mean LC₅₀ for one additional species, Daphnia magna. More significant is the fact that the mean background concentration exceeds the level established in the Tennessee Water Quality Criteria (one-tenth the LC₅₀) for three of the species--Daphnia magna, Daphnia pulicaria, and Pimephales notatus. Furthermore, the maximum background concentration exceeds one-tenth the LC₅₀ for five of the seven species listed--Daphnia magna, Daphnia pulicaria, Cyprinus carpio, Pimephales notatus, and Morone saxatilis.

Although the above experiments were performed in laboratory

NRDC-25 water in which copper might have a different degree of toxicity than in the waters of the Clinch River due to differences in hardness and other aspects of water chemistry, the data presented above represent a substantial body of scientific evidence and no other information on the toxicity of copper is presented in the draft NPDES permit, the permit rationale, or the DES. According to these data, the maximum concentration of copper in the Clinch River (170 ug/l) exceeds the Water Quality Criteria set by the State of Tennessee--1/10 the LC₅₀ for sensitive resident species. (The average ambient concentration of Cu--36 ug/l exceeds 1/10 the LC₅₀ for three resident species.)

In addition, according to Table A3.2 in the DES, the discharge to the river from the breeder facility would contain an average of 200 ug/l and a maximum of 930 ug/l of the pollutant copper. It seems likely that this would cause a violation of Section 4(b)(i) of the Tennessee Water Quality Criteria for mixing zones, which says that concentration of pollutants shall not "exceed the 96-hour LC₅₀ for biota significant to the aquatic community in the receiving waters." Yet this issue is not addressed in the draft NPDES permit, the permit rationale, the DES or the June 9, 1982, letter of certification from the Tennessee Department of Health. Table 3.6 of the February 1977 FES for the breeder reactor does address the relationship between effluent concentrations and state water quality criteria, but does not list any specific criteria for copper, apparently

because none existed at the time the chart was prepared.

NRDC-25

C. Deficiencies in the Permit and Certification

Based on the above information, it appears that the segment of the Clinch River into which the wastes from the breeder reactor would be discharged is a water quality limited stream for the toxic pollutant copper. Consequently, a Total Maximum Daily Load (TMDL) should have been estimated, and a Waste Load Allocation (WLA) performed in order to incorporate water quality-based effluents in the NPDES permit, in accordance with Section 303(d) of the Clean Water Act. No mention is made of a TMDL or WLA in the draft NPDES permit or the permit rationale prepared by EPA, or in the DES written by DOE and TVA.

Furthermore, the letter of certification for the discharge sent on June 9, 1982, by the Tennessee Department of Public Health to the Acting Director of the Breeder Project, EPA, and DOE pursuant to Section 401 of the Clean Water Act, makes no mention of specific state water quality criteria, provides no toxicity data, and gives no indication that any attempt was made to determine whether the Clinch River was water quality limited for any pollutants to be discharged by the breeder reactor, much less whether a TMDL or WLA allocation was performed.

In fact the letter of certification fails to comply with Section 401 of the Clean Water Act. At no point does it assert that the Tennessee Department of Health or any other agency of the State of Tennessee made a positive determination that state

NRDC-25 water quality standards and criteria are not and would not be violated. Rather, the letter simply states:

1. Permittee is in no way relieved from any liability for damages which might result from the discharge of wastewater.
2. Permittee must additionally comply with all requirements, conditions, or limitations which may be imposed by any provision of the Tennessee Water Quality Control Act (T.C.A. Sections 70-324 through 70-342) or any regulations promulgated pursuant thereto.
3. The State of Tennessee reserves the right to modify or revoke the certification or seek revocation or modification of the NPDES Permit issued subject to certification should the State determine that the wastewater discharge violates the Tennessee Water Quality Control Act, or any of the applicable Water Quality Criteria, or any rules or regulations which may be promulgated pursuant to the Clean Water Act of 1977, Public Law 95-217.

Stating generally that the permittee should comply with all relevant sections of state law and regulation without having determined -- based on available information -- that violations will not occur (or requiring the permittee to provide evidence of compliance prior to certification) does not comply with Section 401 of the Clean Water Act. And merely reserving the right to revoke the certification or seek revocation or modification of the permit does not cure that noncompliance.

D. Other Issues

1. Re: Outfall No. 002--Sewage Treatment Unit Effluents
(page I-2).

The note regarding additional units is confusing. The first sentence states, "Additional units may be added (or subtracted) provided that each individual unit does not exceed the above limitations or its individual flow. A process modification may be made during the construction phase to the existing system to allow increased flow; however, all other discharge limitations shall apply." This seems to mean that the permittee could greatly increase the flow of effluents so long as the concentration of pollutants listed in the permit are not exceeded. This could result in substantial increases in pollutant loadings in the receiving water. Such changes clearly should not be allowed without review and approval by the permitting agency. The last sentence in the note, "In either case, proper application must be made to EPA and the State of Tennessee prior to institution of any changes," seems to require the approval we believe is necessary. This note should be revised to clarify this ambiguity.

2. Re: Outfalls No. 003 through 008--Point Source

Runoff (pp. I-3 and I-4).

The permit fails to set definite limits on the amount of Total Suspended Solids (TSS) contained in runoff from the facility. It simply says that if the TSS concentration exceeds 50 mg/l, the permittee "shall evaluate system performance to assure that the system is operating as designed and that on-site controls are effective. Permittee shall take appropriate

NRDC-25 corrective action as required." The permit should clearly state that if the concentration of TSS exceeds 50 mg/l, steps must be taken to bring the concentration down below this level.

3. Re: Outfall No. 009--Waste Water Treatment System
(p. I-5).

The allowed daily maximum for TSS appears to be unusually high. It should be set at 45 mg/l, as requested by the State of Tennessee in its letter of certification, with regard to Outfall 002, unless this is clearly infeasible.

4. Re: Outfall No. 012--Pre-Operational and Other Metal Cleaning Wastes (pp. I-8 and I-9).

Limits are placed on the concentration of pollutants in each batch discharge, but no limits are set for the size of any given batch discharge or the number of discharges over a specific period of time. Such limits should be set.

Since the Clinch River appears to be water quality limited for the pollutant copper, and since off-site disposal is technically and economically feasible, no discharge of copper should be permitted.

5. Re: Other Requirements, A (p. III-1).

The implication that if the permittee meets the effluent limits for the first 18 months of operation the monitoring requirements could be substantially reduced or eliminated is of concern. Considering the nature and size of the facility, frequent monitoring should always be required, particularly as

the facility ages. The proposed permit requires daily monitoring NRDC-25
for most limited parameters, which can be accomplished
inexpensively using current technology. This is by no means an
onerous burden on a facility costing several billion dollars.

6. Re: Other Requirements, C (III-1).

The present wording regarding additional monitoring of the
main plant discharge (001) and the plant intake (013) to assure
conformance with applicable water quality standards is confusing,
since such standards apply to the receiving waters, not the
effluent. How and by whom will the determination of compliance
be made? Why not simply require monitoring of the receiving
waters?

7. Other Requirements, G (p. III-3).

Waiting 12 months after the onset of operation to obtain a
priority pollutant scan seems unwise. If significant levels of
toxics were being discharged, substantial amounts could
accumulate in the river during the course of 12 months. A
priority pollutant scan should be done 3 months after the onset
of operation, followed by scans at 6 months and 12 months.

8. Other Requirements (p. III-3).

The current language requires notification of EPA and the
State prior to instituting use of any additional biocide or
chemical in cooling systems, other than chlorine, which may be
toxic to aquatic life (emphasis added). This wording leaves the
determination of potential toxicity up to the applicant, and

NRDC-25 could result in failure to report use of a harmful chemical. The language should be changed to require reporting of the use of any new biocide or chemical, leaving the determination regarding potential toxicity up to EPA and the state.

9. Testing

A further comment regards the letter of certification sent by the State of Tennessee. Item #7 of that letter states that the permittee must submit to the State, for review and approval, a plan for toxicity screening of discharge 001. We would suggest that both acute and chronic tests be required. Acute tests should be performed at 3, 6, and 12 months after onset of operations, and the results of chronic tests should be reported by 12 months.

Given these inadequacies in the draft NPDES permit and the State of Tennessee certification, the NRC cannot adequately assure that the impacts to aquatic ecology and endangered species from CRBR construction and operation would not be significant. Those sections of the DES dealing with water quality impacts must therefore be revised.

SECTION 4.2, Impacts on Land Use

NRDC-26

NRDC disagrees with the statement by the Staff that the increase of approximately 50% in land use is not significant, because the entire 1364-acre site is zoned for industrial development. The criteria for determining whether an environmental impact is significant is not a comparison with any planned future use of a particular site. Rather, the criteria is a comparison of the land use proposed by the project with the existing land use, which in this case is mostly forest land, including several areas of particular ecological significance.

On page 4-2, Figure A4.1 does not appear to be up-to-date, particularly regarding the existence of the Indian burial mound. On page 4.4, the sentence on the last line is not complete and apparently several lines are missing.

SECTION 4.4.1, Terrestrial Ecological Impacts

NRDC-27

We believe that the increase of 50% land clearance and the proportional increase of the amount of biota affected is a significant increase regardless of the fact that the biota affected would be less than 1% of such resources on the Oak Ridge Reservation. It is unclear from this section whether or not other areas of the site besides the 45 acres for the quarry will be restored and, if so, how long such restoration will have to occur before wildlife and habitat would be restored to their present levels.

NRO-28 SECTIONS 4.4.2, Aquatic Ecological Impacts, and 5.3.4,
Threatened and Endangered Aquatic Species

In general, these sections must be updated to reflect the Staff's analysis and conclusions in the NRC Biological Assessment, although that assessment regarding endangered mussels is inadequate in several respects. First, as noted above, a biological assessment of impacts must also be performed for Dromus dromas, Fusconaia cuneolus, Fusconaia edgariana, and Pleurobema plenum. Second, the biological assessment for L.o. orbiculata fails to consider several important potential impacts of a zero flow condition at the Clinch River. Any zero flow condition (which the Staff estimates to occur on an average of 17-32 days per year) might cause the L.o. orbiculata glochidia to settle to the bottom, fail to attach to a host fish, and smother in the sediment. Zero flow conditions, depending on the amount of organic sediment present, might also kill the glochidia through reduction in oxygen and pH conditions. Zero flow conditions might also impact the riffle species noted above.

Third, the NRC Biological Assessment claims that L.o. orbiculata utilizes the sauger, Stizostedion canadense, as a host fish, but that the sauger is not expected to be detrimentally affected by plant operation. This assertion (which should be supported by sufficient evidence) is belied by the evidence in the DES that the sauger uses the Clinch River

for spawning and will be affected unless certain protective measures are used. As discussed below, the Staff has not adequately demonstrated that such measures will be sufficient, or even that they will be adequately implemented. The Biological Assessment should consider the effects on L.o. orbiculata and other mussel species if host fish populations are weakened.

NRDC-28

In general, both the NRC Biological Assessment and the DES fail to present meaningful information regarding the extent and characteristics of the potential siltation load and other parameters affecting endangered mussels. For example, on page 34, it states that sediment discharge to the Clinch River will be controlled in accordance with an erosion and sediment control plan. However, no estimates are given of the amount of sediment that is expected to escape into the Clinch River from rainfall or runoff and the effect of that sediment upon the endangered mussel species. Similarly, Staff admits that the project construction will include dredging from construction of a barge unloading facility and intake and discharge structures and placement of granular film materials. The Staff states that siltation of the river bottom due to these activities will be minimal, simply because construction of these facilities will be scheduled separately to minimize impact. There is no discussion of what the impact will be, what the additional siltation will be, and what effect this additional siltation

NRDC-28 will have upon the endangered mussels. The Staff also notes that construction of the CRBR will result in the disturbance or loss of about 1.1 acres of river bottom, yet there is no discussion of what the effects of such disturbance or loss would be upon endangered mussels.

In Section 6.2 of the Biological Sssessment the Staff discusses the impact on L. o. orbiculata due to plant operations. The Staff admits that scour of the bottom in the immediate downstream vicinity of the discharge structure could potentially affect or exclude L. o. orbiculata, but the discussion of these impacts is inadequate.

Page 37 of the Biological Assessment states that the NPDES permit limits effluent discharges to levels that will not result in any acute or chronic effect on fresh water mussels inhabiting the bottom downstream of the discharge. Yet the NPDES permit contains no discussion of the effects upon endangered mussels of nonradioactive chemical discharges.

On page 38 of the Biological Asessment the Staff states that the worst-case condition of extended zero-flow would increase the temperature of only a small area of river bottom. No estimates are given of the estimated increase in temperature or the area of river bottom concerned. No effort is made to discuss the possibility of long-term reproductive effects on L. o. orbiculata, although the Staff admits that such effects may occur. The Staff also admits that increased radiosensitivity

may result from environmental interactions with other stresses (e.g., heat, biocides). Yet the Staff has made no effort to determine whether these environmental interactions might occur at the Clinch River site, particularly interactions with chemical effluents from the proposed synfuels plant or the Oak Ridge National Laboratory. NRDC-28

In discussing the effects of radiation exposure to L. o. orbiculata, the Biological Assessment only discusses impacts from routine plant operations. The Staff must also consider the effects on endangered mussel species of CRBR accidents and related radioactivity.

Striped Bass

The discussion on page 2-18 of the impact statement concerning the impacts upon striped bass is also inadequate. NRDC-29
The Staff states that it is thought that a significant portion, perhaps the major portion, of adult striped bass inhabiting Watts Bar Lake utilize the Clinch River in the vicinity of the proposed CRBR site during periods of high thermal stress in the main reservoir. The Staff also notes that water temperature is of extreme importance to the striped bass fishery. Yet the DES and the NRC Biological Assessment both fail to provide sufficient information regarding the exact amount of heat that will be discharged to the water, the vertical and horizontal distribution of excess heat in the water body around the site, and the potential effects of this thermal discharge on the

NRDC-29 striped bass, particularly during the late summer or early fall. Rather than analyzing these impacts in the DES, NRC and EPA merely require the Applicants to perform studies at a later date. This procedure effectively screens from public view and NEPA comment the results of the Applicants' studies and the adequacy of EPA and NRC's approval, disapproval, or enforcement of any proposed mitigation measures. NRDC believes the NRC should prepare an impact statement supplement once these studies are complete. Until such a supplement is prepared, any NRC Staff conclusions that the striped bass will not be adversely affected are speculative only and cannot be relied upon. In particular, in analyzing alternative sites, the Staff should assume until proven otherwise that some impacts to striped bass will occur at the Clinch River site.

NRDC-30 On page 219, the Staff discusses the existence of a state endangered fish species, namely, the blue sucker Cycleptus elongatus, in the vicinity of the site. However, there is no discussion of the effects of Clinch River Breeder Reactor construction or operation upon this endangered species, nor is such discussion contained in the August, 1982 biological assessment. We believe a biological assessment should be performed for the blue sucker, particularly since specimens have been taken in Watts Bar Lake on two occasions.

Sauger

NRDC-31

On the bottom of page 4-5 of the DES, the Staff recommends certain features to reduce impacts to the sauger. There is no requirement at this time, however, that such recommendations be imposed as license conditions. For this reason, the Staff must examine the environmental impacts of the project if this and other recommendations are not included as conditions. This same comment applies to the Staff recommendation on page 4-6, that fill material not be placed in the river during late spring when sauger are spawning. The Staff must also consider the effects of accidental radiological releases and thermal and other chemical discharges upon the sauger, particularly since the highest sauger catch rate reported by the Staff was immediately below the proposed discharge structure.

General

NRDC-32

On page 4-6 of the DES, the Staff concludes that aquatic life would be destroyed in the area of the barge unloading facility. The Staff must discuss the amount and types of aquatic life that would be destroyed, and examine the effects of such destruction upon other aspects of aquatic ecology. The Staff also claims that areas severely affected by soil erosion and stream siltation due to construction would be "recolonized." The Staff must include a description of the ways in which these areas will be seriously affected, the amount of time needed for recolonization, and whether full recolonization is possible.

NRDC-33 The Staff states that about 11,000 cubic yards of material will be dredged from the river to accomodate the barge facility, and that other dredging will also be required. The Staff should also consider whether, at some later date, additional dredging will be necessary for stream channelization in order to enable barges to travel between the facility and

NRDC-34 the barge port. Furthermore, it appears that the material to be dredged from the bottom of the Clinch River contains significant amounts of radioactivity because of previous activities at the upstream Oak Ridge National Laboratory. In particular, Oak Ridge National Laboratory, "Status Report No. 5, Clinch River Study" (ORNL-3721), October 1965, reported a maximum dose measurement over stream channelization spoil deposits at Jones and Grubb Islands (within the general area of interest) that was 455 mrem, including background. ORNL-3721 at 86.) Based on this information and on the fact that the Applicants' sedimentation sampling program appears to be inadequate, NRDC believes that the potential exists for relatively high doses resulting from the dredging associated with the Clinch River Breeder Reactor. In particular, the DES is inadequate because it contains no information as to where this dredged material will be placed and no information on what the potenial doses of radioactivity from this dredged material might be.

Applicants' Environmental Report, Table 2.8-8 at page 2.8-39, indicates cesium concentrations in sediment at the intake outfall and barge loading areas as high as 10 to 15 picocuries per gram dry weight. Because the sediment sampling was not based on a fine grid, it appears that substantially greater activity levels may occur in the actual dredging areas. In any event, in order to estimate the radioation exposures over CRBR dredge spoils, these levels should be compared to the activity levels in the sediment placed on Jones and Grubb Islands following channel improvement dredging in and around Jones Island and Grubb Island in October, 1962 and June, 1963.

NRDC-34

SECTION 5, Environmental Impacts of Plant Operation

SECTION 5.7.2.2, Liquid Effluents

The Staff does not indicate what assumptions were used in the calculations of dose to the whole body and the internal organs in Table A5.2. Presumably the Staff's calculations were based on the ICRP 2 dose conversion factors. The calculations should be updated using the dose conversion factors from subsequent ICRP publications (see, e.g., NUREG/CR-0150). The Staff should calculate the bone surface dose rather than the bone dose (right hand column of Table A5.2), given that the ICRP and other radiation standards bodies are now in agreement that the bone surface and bone marrow are the critical organs, rather than the entire skeletal bone.

NRDC-35

NRDC-36 On page 5-12 the Staff estimates that the total body dose to a hypothetical individual who receives all drinking water from the planned discharge region at the Clinch River was estimated to be less than .1 milligram per year. NRDC believes that this calculation and the calculation of the dose due to fish ingestion in Table A-5.2 are understated due to the failure to consider resuspension of radioactivity in the sediments associated with barge traffic and dredging and the stirring of the sediment at the outfall pipe at the discharge region of the outfall line.

SECTION 5.7, Radiological Impacts from Routine Operations

NRDC-37 A glaring deficiency in this section of the DES is the lack of any analysis by the Staff as to whether or not the proposed operations at the CRBRP will meet the requirements of 10 CFR Part 20. Under that section the licensee must control his activities in such a manner that the total dose to an individual from his activities and exposures to licensed and unlicensed radioactive material and to other unlicensed sources of radiation, whether in the possession of the licensee or any other person, does not exceed the standards of radiation protection prescribed in Part 20. In Section 5.7 the Staff evaluates the radiation exposure from routine CRBRP operations but does not calculate the total radioactive doses when these are added to doses from activities at the Oak Ridge National Laboratory, the Y-12 Plant, the Oak Ridge Gaseous Diffusion

plant, and the proposed developmental reprocessing plant, which NRDC-37
is scheduled to be constructed only two miles from the CRBRP
site.

SECTION 5.7.2.2, Liquid Effluents

Larsen and Holdham (Science Vol. 201, 15 Sept. 1978, pp NRDC-38
1008 - 1009) found that the gastrointestinal absorption factor
for soluble plutonium is strongly dependent on whether the
water is chlorinated. The consequence of this observation is
that the current methodology used for calculation of the
plutonium dose contributions associated with liquid effluents
are understated by several orders of magnitude for the water
ingestion pathway where chlorination treatment is utilized in
water treatment plants. This effect should be examined,
particularly in the calculation of the Oak Ridge gaseous
diffusion plant intake pathway in Table A5.2.

SECTION 5.7.2.5, Occupational Radiation Exposure

The NRC Staff has utilized risk estimators taken from the NRDC-39
BEIR I Report. These risk estimators are more appropriate for
population exposure rather than occupational exposure. NRDC
disagrees with the Staff's statement that the relative risk
model values represent a reasonable upper limit on the range of
uncertainty. Mancuso, et al., in a series of mortality studies
of the Hanford nuclear workers, have estimated a doubling dose
of 15 and 30 rads. These results are consistent with somatic

NRDC-39 risks as much as 20 times greater than the BEIR I linear relative risk estimates, due in part to the limited population, since the data was statistically significant only for certain radiosensitive cancers and the doubling dose confidence limits are very large. Also, recent analyses related to reevaluation of the dosimetry of the individuals exposed at Hiroshima and Nagasaki suggest that the absolute risk model in BEIR I understates the risk by several fold.

NRDC-39a SECTIONS 5.7.2.6, 5.7.2.7, 5.7.2.8, 5.7.3 and 5.8 should be revised to reflect our comments on Appendix D.

NRDC-39b SECTION 6, Environmental Measurement and Monitoring Programs
SECTION 6.1.2, Radiological

The first problem with the Applicants' proposed offsite preoperational radiological monitoring program is that the Staff has not demonstrated that this program will be sufficient to enable the Applicants at the operational monitoring phase to distinguish between CRBR radiological effluents and baseline effluent levels. The Staff should describe the criteria contained in the radiological assessment branch technological position cited and describe the number and location of the additional dosimeters that would be required.

SECTION 6.1.3, Meteorological

NRDC-40

This section is inadequate because of the lack of sufficient details regarding the Staff's methodology and assumptions. Why are no meteorological measurements being taken now? Where are the towers (6-1) located, and how far are they from the site? Why are all of the towers located south of the site ("south", "southeast", "southerly"), when ORGDP, ORNL and Knoxville are north and west of the site? Wouldn't the uneven terrain encourage concentration of radiological releases in certain areas?

Why are releases "assumed to be at ground level" (§ 4 at 6-7)? Why does the Staff use the "Straight Line Trajectory Model" rather than another model? Is there another model available that includes estimates of effects of recirculation and stagnation? Why are "continuous releases only" evaluated (6-7, § 4)? Does this mean that accidental releases (greater concentration -- above ground level) have not been properly evaluated relative to meteorological conditions?

SECTION 6.1.4.1, Aquatic

NRDC-41

This section describes the baseline aquatic monitoring program that was conducted between March, 1974 and May, 1975, as well as a preconstruction effects monitoring program that was conducted between March 1975 and January 1978. NRDC believes it necessary for the Staff or Applicants to conduct an

NRDC-41 up-to-date baseline and preconstruction effects monitoring program rather than relying upon data that is between 4 and 7 years old. This is particularly important since, as noted above, there are possibilities for significant impacts upon several important game species and endangered species in the Clinch River. On page 6-12 the Staff states that the Applicants are now modifying an erosion and sedimentation control plan. The Staff relies upon the existence of the erosion control plan and the recommended scheduling of construction activities in the river for its conclusion that it will not require the studies indicated by the Applicants in the ER. We find it difficult to understand how the Staff can rely upon an erosion control plan that is now being modified and which may ultimately be very different from the one previously submitted to the EPA. In addition, since there is no requirement at the moment that the construction activities will be scheduled as recommended by the Staff, it is unreasonable to assume that such scheduling will occur. We think it prudent for the Staff to require or at least recommend the studies indicated by the Applicants in the ELR to protect the aquatic environment.

NRDC-42 SECTION 6.2.2, Operational Radiological Monitoring Program

The Staff states that no change has been made in this section of the FES, yet this section contained one sentence

only: "The preoperational program would be reviewed by the staff prior to operation." The Staff should, at the very least, indicate whether it is feasible for the Applicants to develop and maintain an operational radiological monitoring program that is able to distinguish clearly between CRBRP radiological effluents and effluents from other facilities and operations. Furthermore, the Staff should indicate whether they will require such an operational monitoring program to distinguish between various effluents and, if such a requirement is not imposed, give the reasons why not. NRDC-42

SECTION 7, Environmental Impacts of Postulated Accidents

SECTION 7.1.1, Classification of Accidents

There are several problems with Table 7.2, which summarizes the radiological consequences of postulated accidents. First, it appears from the site suitability analysis that the bone surface dose rather than the bone dose is controlling at the boundaries of the low population zone. For this reason, Table 7.2 should report the doses to the bone surface wherever the dose to the bone appears. Second, this table only estimates the dose at the site boundary (exclusion area) in two hours and the estimated dose to the population in a fifty-mile radius for the duration of the accident. This table should also include the estimated dose at the boundary of the low population zone for the entire period of the cloud, as required in 10 CFR Part NRDC-43

NRDC-43 100. Third, the estimated doses in this table appear to be based on outdated dosimetric and metabolic models rather than on the new ICRP models; for example, the models utilized in ICRP 30. Fourth, the Staff has not examined and the Table does not reflect the radiological dose consequences resulting from the release of large quantities of sodium. Fifth, with respect to the population dose commitment (man-rem) the Staff has failed to include the dose contribution from tritium, noble gases and carbon-14 beyond the fifty-mile radius. Similarly, the Staff has failed to integrate the dose contributions over the full lifetime of the long-lived isotopes such as carbon-14, iodine-129, and even the strontium and cesium isotopes. Also, the Staff has not included the dose commitment to workers at the proposed DRP.

7.2., Transportation Accidents Involving Radioactive Material

NRDC-44 The discussion in this section is inadequate on several counts. First, the Staff has failed to calculate the actual consequences of a serious accident involving the shipment of irradiated CRBR fuel. Second, the Staff notes that ORNL has estimated that LWR and CRBRP fuels have comparable radioactivity for comparable cooling periods of up to 100 years. On this basis, the Staff concludes that previous analyses of LWR fuel transportation would be applicable to accidents involving irradiated CRBRP fuel. The Staff has

failed to recognize, however, that the cooling period for LMFBR spent fuels is necessarily shorter than the cooling period for light water reactor fuels. Otherwise the LMFBR would fail to achieve its purpose of a short fuel doubling time. With the shorter spent fuel cooling periods associated with CRBRP fuel, the radiological consequences would be larger. Third, the Staff has indicated that it has not analyzed accidents associated with sodium as the cask coolant because the Applicant has not yet proposed the use of such casks. Since this is a reasonably foreseeable application, the Staff must analyze the consequences of an accident involving sodium as a cask coolant. Again, it is well recognized that in order to achieve short fuel doubling times the out-of-reactor plutonium inventory must be minimized; consequently, the spent fuel shipped after a short cooling period would in turn necessitate the use of sodium as a cask coolant.

NRDC-44

SECTION 7.3, Safeguards Consideration

This section should be modified to reflect our comments on Appendix E.

NRDC-45

SECTION 8, Need for the Proposed Facility

SECTION 8.3, The Ability of CRBRP to Meet Its Objectives

It is clear that the CRBRP cannot meet its programmatic objectives without having adequate fuel supply to enable it to operate throughout its five-year demonstration period. In the

NRDC-46

NRDC-46 September 9, 1982, hearings on the Administration's plutonium policy, before the Subcommittee on Energy Nuclear Proliferation and Government Processes of the Senate Committee on Government Affairs, the following exchange took place:

SENATOR GLENN: Do we not now have enough plutonium stockpiled to run Clinch River if it is built?

MR. KENNETH DAVIS: No, sir.

It is clear from this and other exchanges by Deputy Secretary of Energy W. Kenneth Davis and Under Secretary of State Richard T. Kennedy that there is currently an inadequate supply of plutonium to operate the Clinch River Reactor. Furthermore, Mr. Davis has indicated that the Barnwell reprocessing plant must be operating to meet the plutonium needs for the Clinch River Reactor and the FFTF. The Staff must discuss the adequacy of fuel supplies for the Clinch River Breeder Reactor and whether or not sufficient fuel will be available to enable the CRBRP to meet its programmatic objectives.

NRDC-47 SECTION 9.2, Alternative Sites

On April 9, 1977, NRDC and the Sierra Club filed a "Motion to Declare that the CRBR FES is Not a Legally Sufficient FES and to Require that the Aforesaid Document be Circulated for Comment as a Draft" in response to the Staff's addition of a substantial amount of new material on alternative sites in Chapter 9 and 11.9 when the final FES was published.

Due to this rewriting, much of the FES Chapter 9 has not been previously commented on. Accordingly, NRDC's discussion of DES Chapter 9, which incorporates the FES by reference, reflects these charges in the FES. NRDC-47

SECTION 9.2.4, Alternative New Sites in the TVA Area

The fourth criterion on page 9-2 renders the "substantially better" CRBR alternative sites test virtually meaningless. Consideration of whether the choice of an alternative site would affect the project's ability to meet its programmatic objectives would also foreclose any meaningful consideration of alternatives since the Applicants now define one of those objectives as "completion of the CRBR construction as expeditiously as possible". Under this test, the switch to another site would almost always take more time, and thus be undesirable. The last sentence under (4) at p. 9-2 should therefore be deleted.

In ¶ 2 on page 9-5, the Staff should determine whether the choice by Applicants of the second review option would bias or color the site selection process, and whether sites are "passed over" that might be substantially better under the first option. NRDC-48

In (2), the Applicants have the burden of showing no likely further endangerment to federally listed threatened or endangered plant or animal species. As noted above, the NRDC-49

NRDC-49 Applicants' proposed CRBR site fails to meet this threshold test for several species of endangered mussels and four state endangered or threatened bird species.

NRDC-50 Evidently, the Staff in ¶ 1, on page 9-7, relied on TVA environmental statements to determine thresholds and to decide whether that site meets the criteria. Doesn't this mean the threshold criteria may be abused by the Staff and Applicants here, in that criterion (2) is not met for CRBR (and other sites also)? The Staff's review of these 14 candidate sites does not indicate whether this review meets criteria (1) on page 9-1, that the "reconnaissance level information submitted by Applicants is sufficient to support the analyses necessary to reach reasoned conclusions." Furthermore, since the impacts upon endangered mussels were only recently evaluated at the Clinch River, and since most of the 14 candidate sites are located near the Clinch River site, it is reasonable to conclude that these sites should also be reexamined for the presence of endangered aquatic species. There is no evidence that such a re-evaluation has been made, and thus no evidence that these sites meet criterion (2) on page 9-5.

NRDC-51 In ¶¶ 2 and 3 on page 9-7, criterion (1) calls for examination of "at least four sites" and the Applicants came up with just four, although 13 sites apparently met criteria (1) to (8). Why were only four sites examined? Regarding criterion (3), isn't selection of another site on the Clinch

River mandatory under the proposed rule? The Staff's reasons NRDC-51
for not selecting another site on the Clinch River are
inadequate. See ¶ 1, at 9-8. It is not enough to say that the
aquatic impacts are likely to be greater at another site. The
staff must select and evaluate one of these particular sites in
detail before reaching that conclusion, rather than using a
speculative conclusion to avoid particularized evaluation.

SECTION 9.2.5, Selected Alternative Sites in the TVA Service
Area

On page 9-8, note the striped bass effect during periods of NRDC-52
no-flow, which averages 17 days/year. What is the procedure by
which dam regulation would be coordinated with striped bass
thermal sensitivity? The Applicants would have a "commitment"
to restrict thermal discharges, according to the NPDES permit
(see ¶ M, p. H-28), but what is "minimal" impact on the bass
(permit, H-28) and who decides whether such "minimal" impact
has occurred? Why is there no population sampling of the
striped bass in the NPDES permit -- all analysis is based on
temperature, stream flow, thermal plume, thermal modeling
information, but not an analysis of the striped bass itself?
For example, in ¶ N of the NPDES permit, only water quality and
biotic conditions are examined.

The Staff rests the lack of superiority of each alternative
site on this NPDES permit and its required limitations, which

NRDC-52 appear inadequate to ensure protection for the striped bass, and which in any case do not address the effect on any species of endangered mussels.

NRDC-53 On page 9-9, ¶ 1, since units at the Hartsville, Phipps Bend, and Yellow Creek sites have been cancelled or deferred, and since substantial work on construction already been completed, the environmental advantages of siting the plant on already cleared areas should be considered again. Regarding the Staff assertion that other future developments of the Clinch River site would have the same impacts as an LMFBR plant, this would be true only if another nuclear plant was built. The most severe impacts of the CRBRP all relate to thermal and radiological discharges, impacts which are not comparable to other industrial uses.

Given these cancellations and the limited construction already accomplished, the degree of environmental preferability of Hartsville, Phipps Bend, and Yellow Creek must now be re-examined and evaluated.

NRDC-54 For cost escalations, won't the actual amount and kind of construction at alternative sites Hartsville, Phipps Bend, and Yellow Creek affect the estimates on Table A9.3? This table should be redone. Also, Table A9.3, superseding FES Table 9.4, is vague and lacks meaningful detail of the type found in the FES Table. The FES Table included sources and specific breakdowns of costs at three sites; the same approach should be used on Table A9.3 for the four TVA sites under review.

On page 9-10, if the computer CONCEPT approach cannot be applied meaningfully to the LMFBR, why does the Staff use it anyway? Furthermore, without an adequate independent check of Applicants' figures in Table A9.3, the Staff should not rely on those figures.

NRDC-55

On page 9-10 of the FES, ¶¶ 4,5 seem to conclude that the TVA chose the CRBR site in order to reserve other sites for commercial power plants. Shouldn't this criteria be reexamined now?

NRDC-56

SECTION 9.2.6, Alternative TVA Sites Outside Its Service Area
and Alternative DOE Sites

On page 9-11, Table 9.5 of the FES is incorporated by reference. According to this table the Hanford site is preferable on terrestrial and aquatic impacts, nearby facilities, land use onsite, atmospheric dispersion, flooding, population within 50 miles (400,000 less) population exclusion boundary (which is 15 miles as opposed to 2200 feet for CRBR), population center distance, and site size (360,000 acres, as opposed to CRBR - 1,364 acres) (FES at 9-13).

NRDC-57

The updated population figures show that the city of Richland has grown to 33,582, but these are 1980 census figures, and won't reflect recent layoffs and outmigration. The new 50-mile population is 830,840 (CRBRP) versus 263,000 (Hanford), or now 560,000 less for Hanford.

NRDC-57 These site isolation factors obviously have not been given adequate weight in the Staff's evaluation regarding safety. The Staff's characterization of atmospheric dispersion and site isolation factors, both vital safety-related factors, as "somewhat more favorable" at Hanford, Savannah River or INEL, constitutes a misapplication of the proposed alternative sites rule they purport to follow, in that the differences between these sites and the Clinch River site are clearly substantial.

NRDC-58 What does "participate extensively" mean? (next to last ¶, page 9-11) There is no evidence in either the DES or the FES that the utility groups in the vicinity of INEL are unavailable at this time to participate in the project. The FES rejects the Hanford site on the basis of the assertion that technical, managerial, and financing already allocated to other nuclear development would not permit construction of a LMFBR there. Since this situation has changed, this FES conclusion is invalid. (FES, page 9-14, ¶ 1.)

SECTION 9.2.6.1, Schedule Impacts

NRDC-59 What does the Staff mean by "today's regulatory climate"? (¶ 1, page 9-12) Aren't these procedures actually being sped up, not delayed, by the current administration? The cost of delay and schedule impacts should accurately reflect the possibility of an accelerated effort, as has already occurred in the CRBR licensing process. Instead of revising the estimate from 27 to 36 months, perhaps less than 27 months would be more "reasonable".

SECTION 9.2.6.2, Cost of Delay

NRDC-60

Note the larger revenues for Hanford in the Table at page 9-12. Why is this? Is this revenue estimate still accurate given the recent deferrals at WPPSS? How can cost of delay be adequately analyzed, given the Staff's failure to estimate capital cost and review Applicants' estimate? (See page 9-10 and discussion above)

SECTION 9.2.6.3, Reduced Benefits of LMFBR Program

NRDC-61

Applicant's surrender to the impossibility of accurately determining the costs and benefits of the LMFBR program is glossed over by the Staff, which asserts that "any attempt to update it would be speculative." If so, why would any delay mean reduced benefits? Isn't there a benefit, for example, to risk-reduction by improved reactor design, better safeguards, etc.? Such an updated evaluation of benefits by the Staff is necessary and must be performed.

The Staff has purged from this section its previous conclusion that the Hanford, INEL and Savannah River Sites are better than the CRBR site or any other alternative site. The Staff has no rational basis for the switch to its present conclusion that these sites are not substantially better than the Clinch River site.

NRDC-62

SECTION 9.2.6.4, Radiological Risks

The Staff must update this analysis to reflect changes in CRBRP design, Commission policy regarding the increased need for site isolation, and the uncertainties in CRBRP accident risks.

NRDC-63

SECTION 9.4, Benefit-Cost Comparison

Why would there be no "improvement in the ranking of the alternatives" because design, testing, and procurement are already done? Haven't there been any improvement in the design and testing of other alternative systems since 1977?

SECTION 10 - EVALUATION OF THE PROPOSED ACTION

NRDC-64

SECTION 10.1.1.1, Land

The proposed increase in permanent or long-term land use is from 73.5 to 113.5 acres. This amounts to an almost 50% increase, yet it is characterized by the Staff here as "insignificant compared to the total land available on the Oak Ridge reservation." This increase is undeniably small, compared to a larger land area, but is a very large increase when properly contrasted with the area previously designated in the FES. The Staff should properly evaluate any increase in light of the absolute nature of that increased permanent land use.

SECTION 10.1.1.2, Water

NRDC-65

Although the Staff asserted in the 1977 FES (Section 10.1.1.2) that water consumption of 8 cfs is "about 0.2%" of the annual average river flow, the Staff now asserts that the increased water consumption of 8.3 cfs is still less than 0.2% of the annual average river flow. These figures represent the Staff's attempt to characterize this 20,000 gallon per day increase as "environmentally insignificant." The true significance of this increased use is the increase in blowdown and thermal plume, and resultant environmental effects, as noted above.

SECTION 10.1.1.4, Other Abiotic Effects

NRDC-66

Although the Staff now predicts that local taxes probably would compensate for increased public services needed for the construction work force, their reasoning here seems to omit any consideration of Public Law 81-874, which supposedly will provide federal aid to the school system (Section 4.4.5). The Staff fails to consider the socioeconomic effect of possible suspension or cancellation of these federal funds. In Section 4.5.4 (not Section 4.5.4.4, which does not exist), tax revenues are only "estimated"; here in Section 10.1.1.4, the Staff hypothesizes "additional compensation to the local communities," without any attempt to specify where this additional revenue would come from.

SECTION 10.1.2.1, Terrestrial Biotic Effects

NRDC-67

As in Section 10.1.1.1, the Staff's use of numbers here seems designed to characterize the change as insignificant, rather than adequately to assess the change in impact. The Staff admits that permanent disruption of plant and animal life would increase "proportionately," or by about 50%. Labeling the land and biota affected as "less than 1%" of similar Oak Ridge reservation land only serves to obscure this environmentally significant increase. Additionally, it is unclear whether, by 1%, the Staff is referring to the increase or the total of the affected wildlife. How many endangered birds (see Section 2.7.1.2.2) are possibly nesting in or nearby this permanently disturbed increased area? Neither the Staff nor the Applicants can answer this question without more comprehensive data and analysis.

SECTION 10.1.2.2, Aquatic Biotic Effects

NRDC-68

Why has the Staff changed the method for estimating the excavation impact here, from a 20,000 m³ volume to a 63,000 ft² area? The Staff must state this impact in both cubic meters and square feet, or otherwise indicate the increase or change in impact here, rather than concealing the impact by this descriptive modification. Additionally, the Staff's assertion that such disruption by dredging and filling is "temporary" is supported in Section 4.4.2 only by the

speculation that aquatic life will "rapidly colonize the new rock substrate." The inadequate analysis based on insufficient data in Section 4.4.2 calls into question the Staff's conclusion that excavation impact has not significantly changed since the FES. NRDC-68

Regarding entrainment, if calculations cannot now be exactly made for changes in river flow, how can the Staff accurately calculate the maximum loss of plankton and drift invertebrates, or conclude this loss is not detrimental? Again, this conclusion is not supported by sufficient data in either the FES or the DES. More data must be given to justify the 2.2% maximum loss and its characterization as environmentally acceptable, especially given the destruction by entrainment of 100% of the aquatic life (Section 5.3.1.2). NRDC-69

The speculative conclusion that fish will be able to avoid thermal discharge is not substantiated by data in the DES. Neither has the Staff adequately analyzed the potential harm under abnormal flow conditions, e.g. abnormally high plume temperatures. The greatest threat of thermal discharge, to the striped bass (present in major numbers), is insufficiently explained both here and in Section 5.3.2.2. How will the Applicants' "commitment" to restrict thermal releases be enforced? What of this "commitment" during an emergency situation? How is the necessity for thermal restriction decided, and by whom? The Draft NPDES Permit only calls for NRDC-70

NRDC-70 "no significant impact" and "minimal impact" (Part III, ¶M) to the striped bass, and provides for no biological sampling. Staff's reliance on this "draft" does not ensure adequate protection for the striped bass.

SECTION 10.1.3, Radiological Effects

NRDC-71 This section must be revised to reflect our comments on relevant DES sections, including Sections 5.7, 7, Appendix D and Appendix J.

SECTION 10.2.4, Decommissioning

NRDC-72 In Section 10.2.4.1, the Staff states that, to date "no unacceptable impacts have resulted from reactor decommissioning." What is the meaning of "unacceptable" here? At what level of risk, degree of exposure, or cost does decommissioning become unacceptable?

SECTION 10.2.4.2, Decommissioning Alternatives

NRDC-73 Regarding the SAFSTOR alternative, the removal of assemblies and radwaste would entail similar or greater safeguard procedures, safety considerations, and costs as during plant operation. Any "safe storage" involves such high risk that every endeavor should be made to minimize that risk by careful evaluation and planning. The Staff's discussion is too speculative and conditional to allow such evaluation.

Many assumptions and conclusions are unsupported here by NRDC-74
adequate data. What is the basis for the exposure model used
in ¶2, and why is the 2000 hours assumption "conservative?" In
¶3, Staff fails to consider multiple years of exposure and the
resulting cumulative effect. The deferral of evaluating
disposal of long-lived radionuclides has no rational basis.
The Staff admits this serious disposal issue "is being
considered," but denies the public an opportunity to review and
comment on this issue.

In the ENTOMB discussion, no reason is given for finding a NRDC-75
100- or 150-year entombment period reasonable, and no analysis
is provided of the difficulties and costs of safeguarding
removal of fuel assemblies and wastes as well as protecting the
entombed remains. The DECON discussion is similarly vague and
nonspecific. Note that no "deep geologic disposal facility"
currently exists for disposal of long-lived radionuclides (¶1,
page 10-6).

SECTION 10.2.4.3, Environmental Impacts

Although the Staff attempts to compare impacts here, the NRDC-76
comparison fails due to the Staff's reliance on unknown or
conjectural factors, such as the volumes of waste, amount of
land needed, site and size of disposal facilities, or costs and
viability of "continued security" at the low-level waste burial
grounds. In fact, no provision is given for how these security

NRDC-76 costs might be "shared with the many other users" of the grounds. No specific data is provided; the entire discussion is merely speculative. What is the actual level of exposure designated as ALARA? Does it depend on regulatory standards that may change according to the political climate?

SECTION 10.2.4.4, Experience

NRDC-77 The most significant fact regarding the decommissioning of Fermi I is omitted from the Staff's discussion here: Fermi I was shut down due to a reactor failure that nearly resulted in unprecedented disaster.

As with the NUREG-0586 report, the Fermi I exposure data should accompany any meaningful public review and comment regarding decommissioning experience.

SECTION 10.2.4.4, Experience

NRDC-78 This section should be updated to reflect the current disposition of the Fermi 1 primary sodium and whether or not it will be used at the Clinch River Reactor.

SECTION 10.2.4.5, Cost

NRDC-79 The Staff has failed to provide adequate details to substantiate its discussion here. Given the significant design differences between Fermi I and CRBRP, comparisons of costs between these plants are marginally helpful at best. Additionally, this section does not compare the costs, risks, effects, and benefits of possible alternatives.

SECTION 10.3.4, Replaceable Components and Consumable Materials NRDC-80

What is the significance of the "uncertainties in the fuel recycle philosophy?" Does this "uncertainty" reflect the current opinion, shared by many LMFBR experts, that CRBRP would not even "breed" fuel and thus fail as a demonstration facility?

SECTION 10.4.1.2, Benefit Cost - Electrical Energy Produced NRDC-81

Why does the Staff assume the Applicants' estimate of an average annual capacity factor? The Staff must provide an independent analysis of CRBRP generating capacity, not parrot the Applicants' figures.

SECTION 10.4.1.3, Research NRDC-82

If the Staff cannot accurately estimate the capital cost of CRBRP construction due to unknown research and development expenditures in Section 9.2.5 (page 9-10), why can it estimate research and development costs here? These assertions are unsupported by meaningful data.

SECTION 10.4.1.5, Employment and Payroll NRDC-83

These "expectations" do not address the real possibility of payroll being cut off by plant termination/deferral, in either the construction or demonstration (operation) period. The data in Table A10.1 and analysis here should reflect that possibility.

TABLE A10.2, Summary of Environmental Costs, CRBRP

NRDC-84 Overall, this table does little more than summarize the Staff's foregone conclusions regarding environmental costs, based on inadequate evidence and superficial analysis, and betrays its bias towards a finding of environmental acceptability of CRBRP.

NRDC-85 For example, this table concludes that "no nesting activities have occurred" for the bald eagle, a conclusion not supported by the mere lack of observance of nesting. No detail is provided in Section 2.7.1.2.2 to indicate the extent or method of search for nesting. Given the observance of bald eagles on the site, the impact could continue to be significant on nearby eagle nesting even if a conclusion of no nesting onsite was made later, based on as yet unperformed further studies. The same is true for the other four threatened/endangered bird species observed on the site.

SECTION 10.4.2.2, Monetary Costs

NRDC-86 This section is inaccurate and incomplete in several respects. First, the estimated cost for the CRBRP plant is no longer current. Secondly, the Staff has failed to include the costs associated with the CRBR fuel cycle. For example, DOE has included in its proposed FY 1984 budget \$250 million to purchase plutonium from the proposed Barnwell Plant to fuel the Clinch River Reactor. Estimates of the entire cost of the Clinch River Breeder Reactor program including the fuel cycle have ranged as high as \$6-9 billion.

SECTION 10.4.3, Benefit-Cost Summary

NRDC-87

The Staff's lack of understanding of true benefit-cost assessment is apparent here. Factors are not weighed and assigned reasonable cost values for comparison; instead the staff reaches its conclusions using generalized expressions such as "significant impact," "more expensive," and "acceptably low" risks versus "detrimental effects" of relocation.

SECTION 11.1.7, Site Suitability

NRDC-88

The Staff says there are no changes from the 1977 FES discussion on site suitability. How can this be known if the Staff has not examined new meteorological data? See DES at Section 6.1.3.

SECTION 11.2.15, Frequency of Heavy Fog

NRDC-89

What is the effect of the increase in heat dissipation and blowdown (Section 3.4.1 at 3-5)? Couldn't this increase both the frequency and the density of the 34+ average annual days of fog in the area? What is the effect of fog on the risks associated with commuter traffic? In Sections 11.5.12 and 11.5.13 the Staff speculates about the effect of atmospheric plumes and fogging. In Section 11.5.12, Interaction with Atmospheric Plume from ORGDP (Oak Ridge Gaseous Diffusion

NRDC-89 Plant), the Staff asserts a "very low probability" for interaction of CRBRP plume and the ORGDP plume with a "south or southeast wind," but leaves in doubt the possible combined effects of these plumes with winds from the opposite direction. Are the plumes comparable in size? In Section 11.5.13, Fog on Route 95 and Bear Creek Road, the Staff responds to a comment by the City of Oak Ridge by stating that "the effects of fogging on Route 95 would be similar to those for ORNL, except where the highway crosses the river, when the "value for Melton Hill Dam" is more appropriate. No value for Melton Hill Dam is given. As the town of Oak Ridge pointed out, "these roads carry significant traffic loads during the hours of probable fogging, and effects of fogging on these highways should be considered." (A-41 of 1977 FES) The Staff also speculates that Bear Creek Road "probably would sustain no impact from the CRBRP cooling towers," but provides no support for this statement.

SECTION 11.2.16, Unfavorable Meteorology (NRDC, A-52 in FES)

NRDC-90 The Staff has dropped its assertion in the FES that, for 1-2 hour time periods, atmospheric dispersion at CRBR may be as favorable as at other sites (or, may not be less favorable). The Staff should explain why it has withdrawn both this assertion and the proposed SER evaluation of atmospheric dispersion. Now the Staff has retreated to a lesser standard,

that CRBR has "comparable" dispersion to other nuclear power plants in the northern Appalachian region of the country. That is not the issue. The issue is whether sites with substantially better atmospheric dispersion factors are available, and the Staff must pinpoint with precision what these factors are for both CRBR and other available sites.

NRDC-90

Discussion of dispersion in the FES is left otherwise unchanged (FES at page 11-5, ¶ 1-3), and the Staff relegates atmospheric dispersion to only "one of the factors," to be considered, denying its relative high importance. We believe this treatment of atmospheric dispersion is inadequate given the potential magnitude of radioactive releases at the plant. There is no discussion of dispersion of accidental releases here, or of how such releases would be dispersed differently than routine releases.

SECTION 11.6.7, Enforcement of Monitoring Programs

NRDC-91

We note the continuing refusal of the Staff to discuss this critical issue. There continues to be no discussion of NRC and EPA's enforcement programs in sufficient detail to ensure adequate monitoring and strong enforcement. The need for radiological monitoring is even more important than before, given the increased awareness of the potential for accidents following TMI, the increase in number of fuel shipments, uncertainties in methods for release of noble gases, and other changes in reactor design and estimated emissions.

SECTION 11.7.12, Seismic Considerations

NRDC-92

The Staff had "determined" the appropriate Safe Shutdown Earthquake (SSE) in the 1977 FES, but now retreats to a position where the SSE is only "proposed," and states that the "appropriateness of this earthquake characterization is under review." The decision is therefore being postponed until publication of the Safety Evaluation Report, thus denying public comment or review and avoiding evaluation of the "serious risk to the public or environment" that could result from earthquakes. (Where is the discussion of past earthquakes?) There is no change to the VIII intensity limit but, as NRDC has stated before, a horizontal ground acceleration value of 0.4 is more reasonable than the 0.25 value proposed by the Applicants.

APPENDIX D, Environmental Effects of the CRBRP Fuel Cycle and Transportation of Radioactive Materials

SECTION D.1, Introduction

There is a significant omission in the introduction which has major impacts on the environmental considerations discussed in the remainder of Appendix D. This omission is the failure of the Staff to discuss the availability of plutonium to fuel the Clinch River Breeder Reactor prior to establishment of the closed fuel cycle as described in Figure D.1, page D-3. It is NRDC's contention that there is insufficient plutonium to fuel the Clinch River Breeder Reactor even during its initial 5-year demonstration period. As a consequence, the Clinch River Breeder Reactor will be unable to demonstrate its programmatic objectives during this period. Prior to 1977, it was thought that the fuel for the Clinch River Breeder Reactor would be obtained by reprocessing commercial spent light water reactor fuel in the Barnwell facility. As noted by the Staff on page D-2, at the present time there appears to be little prospect for commercial operation which could support the CRBRP fuel cycle requirements in the near future. Prior to approximately 1981, the Department of Energy believed it could obtain the CRBR fuel requirements for the initial core and the initial reloads from the DOE fuel grade plutonium stockpile, which is now approximately 17-18 metric tons. As a consequence, the heterogeneous core was designed to be fueled with fuel-grade plutonium from this stockpile.

NRDC-93

NRDC-93

As a consequence of weapons demands set forth in the October 1980 and the March 1982 Nuclear Weapons Stockpile Memoranda, the Department of Energy has decided to divert as much of the 17-18 tons of fuel-grade plutonium as possible into the nuclear weapons program. As a consequence, there will be very little, if any, fuel-grade plutonium from the DOE stockpile available to fuel the Clinch River Breeder Reactor in the late 1980s and none in the 1990s. It is likely there will not be enough plutonium even to construct the initial core loading for the Clinch River Breeder Reactor. The Department of Energy is now once again looking for alternative sources of plutonium to fuel the Clinch River Breeder Reactor. See, for example, the testimony of Deputy Secretary of Energy W. Kenneth Davis before the Senate Committee on Government Affairs, Subcommittee on Energy, Nuclear Proliferation and Government Processes, September 9, 1982.

In NRDC's view it is highly unlikely that the Barnwell Plant will ever be operated; therefore this is a very unlikely source of plutonium to meet the needs of the breeder program. The Developmental Reprocessing Plant will not be available as a source of plutonium until after the scheduled five-year demonstration period of the Clinch River Breeder Reactor. It now appears highly unlikely that the necessary plutonium will be obtained from foreign, e.g. British, sources. If plutonium for the first core and initial reloads of the Clinch River

Breeder Reactor is obtained from any source, which NRDC believes is unlikely, the most likely source will be utilizing one of the existing defense program reprocessing plants, either at the Savannah River Plant or the Hanford Reservation to process commercial spent fuel. There is funding in the defense program budget to design a head-end facility for installation at one of these plants to enable DOE to utilize existing defense program processing plants to reprocess commercial light water reactor fuel.

NRDC-93

These facts have two significant consequences in terms of the calculations and results set forth in Appendix D. First, the Staff has underestimated the dose consequences associated with plutonium release, due to their failure to utilize the appropriate plutonium isotopic concentrations associated with high-burn-up of light water reactor fuel and recycled MOX. Secondly, the emissions, particularly from the reprocessing operations assumed in Appendix D, are orders of magnitude smaller than the actual emissions experienced at the existing DOE reprocessing plants, particularly the F separations area at the Savannah River Plant (see discussion below).

NRDC-94

Table D.1 at page D-2 understates the plutonium loading in the CRBRP if the initial core plutonium is obtained from commercial plutonium sources rather than the DOE stockpile (since DOE stockpile use seems unlikely, as indicated above). Figure D.1, page D-3, fails to indicate the source of the initial fuel loading and at least the first few reloads of the

NRDC-94

Clinch River Breeder Reactor. Furthermore, since the facilities identified on this page are hypothetical, it is at least conceivable that the Clinch River Breeder Reactor, if it operates at all, would operate on an open rather than a closed fuel cycle. The implications of this fuel cycle alternative also should be discussed by the Staff.

On page D-4, paragraph 4, the Staff states that an analysis of the conservatively predicted environmental impact from the fuel cycle associated with the CRBR and the transportation of radioactive materials between the supporting fuel facilities is provided in this Appendix. As indicated by our comments above and below, this analysis provided by the Staff is far from conservative.

SECTION D.2, Environmental Considerations

NRDC-95

Table D.3 on page D-6 is incorrect with regard to the plutonium and uranium loadings of the CRBR in that it is based on the use of fuel-grade plutonium rather than reactor-grade plutonium as a source of plutonium for the Clinch River Breeder Reactor. The same comment applies to Table D.4 on page D-7. In Table D.4 the radiological effluents associated with reprocessing are grossly non-conservative when compared to the effluents from the F Separations area at the Savannah River Plant. See, for example, C. Ashley and C. C. Zeigler, "Release of Radioactivity at the Savannah River Plant 1954-1978", DPSPU 75-25-1, February 1980. The Staff, for example, has assumed a

retention factor (defined as the ratio of plant input to the total environmental effluent of all plant sources) for plutonium which is one order of magnitude larger than that experiences of the F separations area for atmospheric releases in recent years, and two orders of magnitude larger than the average experience over the history of the F separations plant. Similarly, the Staff assumes zero liquid effluents whereas the F separations area at the Savannah River Plant has released substantial curie amounts to seepage basins which in turn are sources of liquid effluents streams which have produced offsite releases.

NRDC-95

SECTION D.2.1, Fuel Cycle Impacts

Page D-8. What is meant by the term "time frame of interest" for CRBRP?

NRDC-96

SECTION D.2.1.2, Core Fuel Assemblies

On page D-9 the Staff states "the DOE assessment conservatively used as a cleanup factor [the inverse of the retention factor defined above] of 1.25×10^{-8} (two orders of magnitude lower than theoretical) and the Staff finds this to be an acceptably conservative approach." These same filter banks are utilized at the Rocky Flats Plant. Since the Rocky Flats Plant is in operation, whereas the SAF is a hypothetical plant, it would appear more appropriate to use a cleanup factor that is representative of a real operating plant rather than a theoretical one. NRDC believes that the Staff's

NRDC-97

NRDC-97 assumed cleanup factor of 1.25 E^{-8} is nonconservative in this regard, particularly in light of accidental plutonium releases which have exceeded routine releases at Rocky Flats. The isotopic concentrations in Table D.5 at page D-10 are nonconservative for reasons stated above. Similarly, the curie release assumptions in Table D.6 are nonconservative both because of the Staff's use of a nonconservative plutonium isotopic concentration and a nonconservative assumption with regard to the cleanup factor. The Staff should compare the radiological effluents associated with fabrication at the Kerr-McGee Plant of the initial core and for several reloads of FFTF fuel against the assumptions used by the Staff to estimate the effluents from the SAF lines.

SECTION D.2.1.3.1, Developmental Reprocessing Plant (DRP)

NRDC-98 As indicated above, NRDC believes the use of the Savannah River Plant would be appropriate and more conservative with regard to estimating the environmental effects of reprocessing fresh fuel for loading in the CRBRP and recycled fuel. The Staff has failed to provide any basis for its view that the retention factors associated with environmental effluents from the developmental reprocessing plant will be orders of magnitude superior to those currently being achieved by the Applicants at the Savannah River Plant and F Processing Canyon. On page D-12 the Staff's understanding that 12% Pu-240 is the likely candidate for CRBRP fuel is no longer correct, as

indicated above. The plutonium isotopic concentrations in Table D.7 at page D-13 are in error and nonconservative for reasons stated above.

NRDC-98

SECTION D.2.1.3.2, Alternative Reprocessing Plants

The statement at page D-14 that "the Staff understands that these design parameters would be applied to any of the DOE alternatives in the event that one is selected instead of the DRP for reprocessing CRBRP fuel" is incorrect. It is obvious from an analysis of the releases of radioactivity at the Savannah River Plant (see DPSPU 75-25-1) that this statement is false. The plutonium source term, for example, should be one to two orders of magnitude larger than the source term listed in table D.8. At page D-14, the Staff states that the impacts of all releases from these plants [Hanford and Savannah River], including atmospheric releases and liquid releases, have been very small as indicated in the reference documents. This statement is factually incorrect.

NRDC-99

SECTION D.2.2, Waste Management Impacts

The discussion of waste management impacts associated with the CRBRP fuel cycle are incorrect and nonconservative due to the Staff's failure to consider the actual impacts from DOE defense program reprocessing plants. The Staff should examine the solid waste streams associated with the SRP F separations area. Similarly, if the fuel for the Clinch River Breeder

NRDC-100

NRDC-100 Reactor were reprocessed at the Savannah River Plant or the Purex Plant at Hanford there is no assurance that the noble gases would be bottled. Likewise, one would also anticipate that the iodine releases would be larger than those assumed by the Staff.

At pages D-20 and D-21 the Staff should explain fully the basis for their assumed releases from the federal repository rather than simply citing unpublished EPA criteria. The Staff has provided no analysis to support the view that the proposed EPA criteria can and will be met. The Staff should analyze the proposed action, instead of licensing criteria. For example, at page D-21 the Staff should indicate the basis for the estimate of 6×10^{-5} Ci/yr from a repository in salt. The Staff should explain how they calculated that the release of this level is only 7×10^{-5} person-rem. Given that much of the activity is transuranic, why has the Staff limited its examination to whole-body rather than include internal organ doses? All of the underlying assumptions behind these estimates should be set forth in the EIS.

NRDC-101 SECTION D.2.4.3, Dose Commitments from Fuel Reprocessing

The Staff should explain more fully the underlying assumptions behind the calculations presented in this section. Given that the bone surface dose is controlling with respect to the CRBR site suitability source term analysis, the Staff

should also present the bone surface dose. In this regard it NROC-101
should be noted that the current Staff estimates of the bone
surface dose associated with fuel reprocessing operations may
be in error by many orders of magnitude. There would be a
one-to-two order of magnitude error due to Staff's use of
nonconservative source term assumptions with respect to the DRP
rather than the Savannah River Plant F separations area. There
would be another error by a factor of 5 to 6 due to the
nonconservative assumption by the Staff with regard to the
plutonium isotopic concentrations. There would be another
error by a factor of approximately 4 or 5 due to the Staff's
use of the bone rather than the bone surface as a critical
organ and the use of ICRP-2 dose models rather than ICRP-30
model assumptions.

SECTION D.2.4.5, Dose Commitments from Transportation

NROC-102

The Staff should explain more fully the basis for the
estimated 24 person rem dose commitment from transporting CRBR
fuel. For example, it is unclear what the Staff assumed for
the spent fuel cooling time prior to transporting the spent
CRBRP fuel.

Table D.4, page D-7, footnote B refers to values which
would be zero or negligible by comparison. The Staff should
indicate what it considers "negligible" and what values are
being compared against. The values in the table do not include

NRDC-102 any uncertainty limits. This is particularly important with regard to the waste management entries. The Staff must discuss the uncertainties associated with the radiological impacts from management of the CRBRP fuel cycle high level and transuranic wastes.

APPENDIX E, Safeguards Related to CRBRP Fuel Cycle and
Transportation of Radioactive Materials

NRDC-103

SECTION E.1, Introduction

To begin with, NRDC does not believe that the Staff is applying the appropriate criteria to judge the adequacy of safeguards systems at the CRBR and its fuel site. Safeguards measures are of two types, physical security and material control and accounting. Physical security measures are essentially preventative. Their specific purpose, as set forth in 10 CFR 73, is to provide a high degree of assurance that there will be no theft or diversion of material or sabotage of the facility at which the material is used. The appropriate criterion in this regard is a high degree of assurance, not reasonable assurance as suggested by the Staff on page E-1 under its general safeguards criterion number 3.

The primary role of material control and accounting (MC&A) should be to provide continual cognizance of the status of nuclear material in a facility. Material control should provide a timely detection capability that activates the physical protection system to prevent a covert theft or diversion of nuclear material or that initiates response forces if theft or diversion has already occurred. Material control plays a primary safeguard role in rapid assessment of losses or alleged losses. Material control also should provide assurance

NRDC-103 concerning the safeguard status of material during the interval between physical inventories.

The primary role of material accounting is to provide long-term assurance that material is present in assigned locations and in correct amounts. Through its measurement records and statistical analysis, material accounting should provide a loss detection capability to complement the more timely detection capability provided by material control and physical protection. Material accounting plays a primary safeguards role in the accurate assessment of losses or alleged losses. Thus effective material control and accounting is an essential component of the safeguards program designed, in part, to deter and detect diversion.

Effective material control and accounting procedures are necessary to provide assurance that physical protection systems have been effective in preventing theft or diversion. This assurance cannot be provided by the physical security system alone. In sum, to be effective, safeguards, among other things, must be capable of providing both timely and accurate information on the status of nuclear material and facilities. This cannot be provided without an adequate material accounting and control program as well as an adequate physical security program. Physical security is not a substitute for an inadequate material accounting program. Both adequate physical security and adequate MC&A are essential. The Staff is in

error in asserting the second general safeguards criterion on NRDC-103 page E-2 that a proposed safeguards system is adequate if it is only "likely to detect attempts at sabotage, theft or diversion."

SECTION E.2, Safeguards Design Basis Threat

SECTION E.2.1 NRC-DOE Threat Comparisons

NRDC-104

The NRC Staff has incorrectly stated that the NRC and DOE design basis threats are similar. The NRC internal threat, for example, allows for a conspiracy of insiders. This is significantly larger than the design basis threat assumed by DOE, which does not provide for collusion with regard to internal threat. More importantly, both the NRC and DOE design basis threats with regard to the external threat are smaller than that assumed by DOD for protection of nuclear weapons and nuclear weapons material. The Staff must explain in detail the similarities and differences between the NRC, DOE, and DOD threat definitions and the significance of the differences.

SECTION E.2.2, Summary of NRC Design Basis Threats

NRDC-105

Again, the NRC Staff has understated the criterion for judging the adequacy of a physical security system by leaving out the phrase "with a high degree of assurance" in the third from the last line on page E-3 and in the third line on page E-4.

SECTION E.3, DOE Safeguards for Plutonium Conversion

NRDC-106 SECTION E.3.1, Physical Security System Description

In the second paragraph under this section, on page E-4, the Staff states that "during the first five years of CRBRP operation, plutonium for the core fuel would be obtained from DOE stockpiles." This statement is not true, as discussed in our comments above on Appendix D, Introduction. Again we refer the Staff to the testimony of DOE Deputy Secretary W. Kenneth Davis and Under Secretary of State Richard T. Kennedy before the Senate Committee on Government Affairs, on September 9, 1982. Furthermore, in this section the Staff has failed to analyze the adequacy of the safeguards systems at the existing DOE facilities that may be involved in the CRBR fuel cycle. There is ample evidence, for example, in GAO assessments of these facilities that the safeguards programs at these DOE facilities are not adequate. A resurrection of the general types of intrusion detection systems (defenses and security clearances) does not assure that the appropriate physical security criterion is being met. The Staff cannot rely on assurances by the Applicants that the physical protection system at these DOE facilities is adequate any more than they can rely on the PSAR for assurance that the CRBRP will be built safely. The Staff must make its own independent analysis of the adequacy of these physical security systems. The Staff should identify in this section each of the independent analyses of the DOE physical protection systems including the

analyses by the Staff and discuss the types of problems that these facilities have experienced. In particular, the Staff should focus on the GAO critiques of the safeguards programs at the DOE facilities. NRDC-106

SECTION E.3.2, Material Control and Accounting System

Description

NRDC-107

The Staff asserts on page E-5 that "the MC&A system, in conjunction with the physical security system, would provide capability to detect and deter the illicit diversion of plutonium and would provide assurance that no diversion has occurred." The Staff has provided no supporting analysis which could serve as a basis for this conclusion. Furthermore, as indicated above, NRDC and, we might add, the NRC Staff believes that material control and accounting must be adequate in its own right and that one cannot rely on physical security as a substitute for material control and accounting, and vice versa. At page E-5 and E-6 the Staff states that physical inventories would be performed on a bi-monthly basis. DOE stated that the limit of error on a one-month material balance for facilities of this type would be about .5 % of throughput and that the limit of error for a two-month balance should be a slightly lower percentage of throughput. The Staff has provided no supporting evidence or evaluation to serve as a basis for accepting the DOE conclusion. DOE's conclusion may

NRDC-107 be in error by a factor of 10 or more. Even if DOE's estimate were found to be correct, the Staff has provided no basis for a view that these inventory differences are adequate in light of the primary role of material accounting to provide long-term assurance that material is present in assigned locations and in correct amounts. Furthermore, there is no discussion and no basis for assuming that the material control procedures at this facility are sufficient to ensure timely detection of the theft or loss of special nuclear materials. On page E-6 the Staff states that "safeguards for the conversion facility would include a prompt accounting system . . ." There is no discussion of the feasibility of implementing such a system at the conversion facility and, equally important, no discussion of whether such an accounting system would in fact be provided. With regard to the first, it is not enough simply to note that R&D is being conducted; and with regard to the last, it should be noted that there have been studies by DOE consultants, for example by Pacific Sierra Research, that indicates that most advanced safeguards systems that have been developed by DOE and others are simply never put in place in DOE facilities due to lack of funding or desire to improve the safeguards at the DOE facilities.

NRDC-108 SECTION E.3.4, NRC Assessment of Plutonium Conversion Safeguards

This discussion is conclusory in nature and lacks any analysis to support the conclusions. Furthermore, as discussed

above, the wrong criterion is applied, i.e., "reasonable assurance" instead of a high degree of assurance, and there are no criteria set forth that define whether the detection occurs in a "timely manner". The Staff also states that the communication systems would enable onsite and offsite forces to respond in a fashion to deter and prevent attempted adversary actions. The inference here is that the Staff believes it is acceptable to rely on the response of outside forces for determining the adequacy of a physical security system. Surely this is not the case at either Hanford or the Savannah River Plant. The Staff asserts that the safeguards systems at this facility could assure that risks from the design basis threat are no greater than at other currently operated U.S. nuclear facilities handling significant quantities of SNM. The Staff should provide a basis for this conclusion and, if it is true, a basis for the underlying assumption that the safeguards at the existing facilities, for example at the Savannah River Plant, are currently adequate. NRDC, and apparently GAO, believes that they are not adequate.

SECTION E.4, DOE Safeguard System for Fuel Fabrication Facilities

The same comments made with regard to the DOE safeguard system for plutonium conversion apply here as well and will not be repeated.

SECTION E.6, DOE Safeguard System for Reprocessing

NRDC-110

Again the same general comments made previously about plutonium conversion apply to the reprocessing operations and will not be repeated here. On page E-12 it is stated that "for a yearly material balance, the accounting system limit of error is stated to be in the range of 0.7 % of the throughput of the DRP. This is equivalent to seven kilograms of plutonium per year based on the annual CRBRP discharge rate of one thousand kilograms of plutonium. First, it should be noted that the use of a limit of error based on a percent of throughput is not a statistically valid basis for a material control and accounting program. We are surprised that the NRC Staff has accepted this in light of the analyses that precipitated the ongoing nuclear material control and accounting rulemaking currently in progress at the NRC. Second, recording the cumulative inventory difference on a yearly basis when the inventory period is monthly, bimonthly, or semiannually, is also an invalid measure of the material accounting uncertainty. Third, the Savannah River Plant in the first half of FY 1981 had a plutonium material inventory difference of 13.8 kg, which greatly exceeds the .7 % throughput limit referenced here. Finally, as noted previously, the Staff has provided no basis for the conclusion that a prompt accounting system will actually work, that it will be put in place by DOE, or that it will meet the requirements of an adequate material control and accounting system and provide timely detection.

SECTION E.6.4, NRC Assessment of Reprocessing Safeguards

NRDC-111

As noted previously with regard to plutonium conversion safeguards, the NRC Staff must provide an analysis of how they reached the conclusions presented here.

As a separate matter, the DRP is not scheduled to operate until 1995. The plutonium required for the initial loading and 5-year demonstration period of the CRBR cannot be provided by the DRP or the existing DOE stockpile. The Staff has provided no basis for a conclusion that a prompt accounting system will be operating and in place in time to provide adequate accounting of the fuel needed to fuel the Clinch River Breeder Reactor during its initial five-year operating period.

SECTION E.8, Transportation Safeguards

NRDC-112

The Staff has failed to discuss the differences between the safeguards implemented by DOE and those required of NRC licensees. The Staff should discuss these differences and indicate whether the CRBR fuel cycle will be required to meet the requirements of NRC licensees.

APPENDIX J

NRDC-113 SECTION J.1.1, Design Basis Accidents

In Table J.1, on page J-2, the Staff compares the doses associated with design basis accidents from CRBRP against those of several light water reactors. With respect to each CRBR dose calculation in Table 7.2, the Staff should explain in detail the nature of the similarities between the light water reactor accidents and the CRBRP accidents that support using the dose calculation from light water reactor accidents to validate the dose for the respective CRBR accident. With respect to each CRBR dose calculation, the Staff should identify each difference between the respective CRBR and LWR accident scenarios and explain why these differences would not significantly affect the conclusion that "the recorded values appear to the Staff to be reasonable." With respect to the doses for the CRBRP, the Staff should display all the assumptions used in these calculations. Furthermore, since bone surface is the critical organ, the Staff should report bone surface dose rather than the bone dose and should do these using current metabolic and dosimetric models rather than models based on ICRP 2.

NRDC-114 Section J.1.2, Evaluation of Class Nine Accidents

On page J-3, the Staff states "as discussed on pages 7-2 and 7-7 of the FES, requirements for the prevention of severe accidents will be imposed on the CRBRP design to insure that

initiation of core disruptive accidents is made very improbable." The Staff should quantify what is meant by the term "made very improbable." In the preceding paragraph, reference is made to core-wide fuel failures as exemplified by propagation of local fuel faults. Is the reader to understand that the Staff's view is that core disruption requires "core-wide fuel failure," or would partial core fuel failure constitute core disruption, in the Staff's view?

NRDC-114

At the bottom of page J-3, the Staff concludes that LOHS events have a frequency of less than 10^{-4} per reactor year. The Staff should set forth in detail the analyses they relied upon to reach this judgment and cite the references that were used. Furthermore, the Staff should explain why they believe that the systems in the CRBR are sufficiently similar to those of a LWR that the LWR reliability figure can be utilized here. The Staff should explain whether the numbers for the LWR were obtained from WASH-1400 or from some other analysis and should cite references. The Staff should explain fully how common cause failures and other multiple failures were factored into the Staff's determination of the 10^{-4} per reactor year probability. At the top of page J-5, the Staff claims that this estimate is also based on the achievement of high reliability in final design and operation through an effective reliability program. The Staff should explain where this reliability program is documented, identify each of the

NRDC-115

NRDC-115 components of "an effective reliability program," and explain the basis for the Staff's view that such a program can and will be effective.

NRDC-116 On page J-4 the Staff indicates that it believes an unavailability of less than 10^{-5} per demand can be achieved for the overall shutdown system of the CRBR, leading to a combined frequency of degraded core accidents of less than 10^{-4} per reactor year. The Staff should explain what estimates it is using for the unavailability of the overall shutdown systems for a light water reactor and where this reliability analysis is documented. The Staff should set forth the basis for its conclusion in detail, indicating what documents it relied upon in reaching its conclusion that, considering common cause failures and multiple failures, the reliability of 10^{-4} per reactor year can be achieved for the CRBR. Staff should indicate what analysis it is relying upon for its conclusion that the systems in the CRBR design will in fact detect fuel failures and faults sufficiently rapidly and with a sufficiently high reliability to insure that fuel failure propagation will not occur.

NRDC-117 On page J-5, the Staff concludes that the overall combined probabilities of each of the core disruption initiating events is estimated to have a net frequency of 10^{-4} per reactor year or less. The Staff should indicate the basis for this conclusion. Given that the Staff is summing over initiators, each of which has roughly the same event frequency of 10^{-4}

per reactor year or less, it appears to NRDC that the sum should have a higher frequency than any of the individual contributors. In previous reliability analyses of the CRBR, the analysts have generally concluded that the sum is a factor of 10 higher than the individual components. The Staff should explain the basis for this difference.

NRDC-117

On page J-6, the Staff should provide the basis for its conclusion that the probability of primary system failure is 0.9 per CDA for categories I, II, and III, and the probability of primary system failure for category IV is approximately 0.1 per CDA. What analyses did the Staff rely upon to reach this conclusion?

NRDC-118

On page J-7, the Staff has estimated that the probability of failure of containment is approximately 10^{-2} per demand or less. The Staff should indicate the basis for this assumption and why such a small probability is used here in light of the fact that in operating LWR plants the containment is not closed during a high percentage (around 15%) of the operating period.

NRDC-119

On page J-7, what is the basis for the Staff's conclusion that overpressurization failure occurs at about 24 hours?

NRDC-120

With regard to Table J-2, at page J-8, the Staff should explain how the bounding estimates of containment release frequency were derived in light of common cause and multiple failures of safety systems.

NRDC-121

In the discussion at pages J-7 through J-10, the Staff should identify the underlying documentation upon which they

NRDC-122

NRDC-122 rely for the estimates of the percentage of core inventory released to the environment under various failure categories. The Staff should explain, for example, the basis for their conclusion that filtered venting will be 97-99% efficient in light of the environmental conditions that the filters will be experiencing under such CDAs.

NRDC-123 At page J-11, the Staff should explain the underlying assumptions behind Staff's conclusions, including where the analysis is documented with regard to the potential atmospheric pathway radiological consequences calculated using the same model used in the Reactor Safety Study.

NRDC-124 In Table J-5, page J-16, the Staff presents a comparison of average values of environmental risk due to selected CRBRP accidents with those of the Midland Plant. Given that considerable information is lost in the presentation of only average risk values, the Staff should display the spectrum of consequences as a function of probability. Again the Staff must explain fully the underlying assumptions behind these calculations.

NRDC-125 At page J-18, the Staff states that "for example, unavailability estimates for shutdown and heat removal systems have been set high enough to include allowances for potential common cause failures." The Staff should explain precisely how this was done in each case where unavailability estimates were made and provide the underlying basis for the Staff's assumption of additional margin that was included to allow for common cause and multiple failures.

Also on page J-18, the Staff states that "quantification of NRDC-126 the frequency of this [high energy] very improbable nonmechanistic event at this time would involve such large uncertainties that the result would have no real meaning." The Staff should explain quantitatively the nature of the large uncertainties in such calculations and should also explain the basis for the conclusion on page J-6 that the primary system failure, category IV, is approximately 0.1 per CDA, if in fact no meaningful estimate of probability of high energetic CDAs can be made at this time.

NRDC-130 relying on the continuing construction of now terminated nuclear plants. The projected population of the Murphy Hill site might also be misleading, see FES, p. 9-8 and chart, DES at 9-11, since it is unclear whether these projections are based on the assumption that the synfuels plant will be built.

NRDC-131 Relative Cost to Make the Project Licensable

The judgment that all sites meet contention (8) is not supported by hard data. The Staff has admitted that capital costs cannot be meaningfully estimated here due to the large R&D component of the capital costs for CRBRP, and to differences between LMFBR and LWR technology (9-10). Also, what is a "significantly different sum of money" (last sentence of ¶ 1)? Is it equal to 5% of the total capital cost? If not, what range of figures are considered significant? On page L-3, ¶ 3, is it reasonable to assume that the cancelled plants will be completed? Given that the Staff assumed that CRBRP would be on "a previously undisturbed portion of each of those TVA sites," aren't all the estimates inaccurate? Elsewhere, the Staff admits that part of the already completed construction might be possibly utilized for a breeder plant. (DES at 9-9).

The proximity of the Y-12, K-25, ORNL, and the proposed DRP facilities, and the possibility of core disruptive accidents at the CRBR site which would certainly affect them, would require additional money to be spent on safety measures, e.g.,

additional safeguards onsite and for transportation. These factors must be considered in evaluating additional sites, particularly since less money would have to be spent on secondary containment and safeguards and other measures at remote sites such as Hanford and INEL. NRDC-131

In 11.3, the Staff lumps the meteorological diffusion differences between the sites into one category: acceptable. This technique appears to blunt the differences between sites which might otherwise show one of these sites to be substantially preferable. As noted in the discussion in sections 2.1.3 and 2.2.3, both Hanford and INEL are in Tornado Region III, and thus have preferable meteorology to the Clinch River site. (L-5,6) NRDC-132

SECTION 1.1.1.4.1, Aquatic Ecology

The Staff assigns no relative weights to the various factors used to judge impacts on aquatic ecology. Without any relative weighting system, the Staff's judgments regarding site preferability appear arbitrary. The Staff's discussion of the possible entrainment or impingement of paddlefish, Polydon spathula at the Hartsville site is inconsistent with their discussion of entrainment at the Clinch River site. Presumably the entrainment of sauger, which spawns near the Clinch River site, would have somewhat similar impacts as the entrainment of paddlefish at the Hartsville site. The Staff has not NRDC-133

NRDC-133 considered the possible situation at Hartsville where many of the construction-related intake and diffuser-related impacts have already occurred, which might elevate the Hartsville site's preferability (L-7).

The Staff's conclusions in ¶ 2, regarding aquatic impact at the Clinch River site, are inadequate for reasons given above.

SECTION 1.1.4.2, Terrestrial Resources

NRDC-134 The Staff's treatment of the eight state endangered species observed at or near the Hartsville site reflects the very reliance on "limited data and subsequent superficial analysis" (K-4) admonished in the proposed rule. The Staff's conclusion of "no significant effect" upon these endangered species is based solely on the unsupported assumption that these species did not appear to be using the sites for nesting activities (L-8).

NRDC-135 The logic of the last paragraph of this section appears unreasonable. The Staff concludes that neither site is "preferable" for population density simply because neither exceeds the 500 person/mi² limit. Isn't preferability properly assessed by how far below the limit these figures are? If so, Hartsville and every other site examined is preferable to the Clinch River site, and some are substantially preferable, such as Hanford and INEL. In addition, the Staff has deliberately omitted the CRBR site data from the population tables for sites other than Hartsville, making a direct comparison more difficult. See Attachment A.

SECTION 1.2, Murphy Hill

NRDC-136

Based on the Staff's analysis of the Murphy Hill site, it appears to be substantially preferable to the CRBR. Geology is equivalent, hydrology is equivalent, water quality, thermal impacts, and dilution flow are better, meteorology is equivalent, ecology is equivalent (although it appears to be preferable, since no threatened or endangered species have been found), socioeconomics is less preferable (but only if the coal gasification plant were built), the population density is much lower, and no industrial/military/transportation facilities are located nearby. The facility makeup flow and blowdown rates at the Murphy Hill coal gasification plant would have been 3 and 4 times, respectfully, greater than for an LMFBR, yet "no significant impacts on aquatic biota were determined." Isn't it possible that the impact on biota at Murphy Hill, with a LMFBR, would be significantly less than at CRBR? If no coal gasification plant is built, Murphy Hill is preferable regarding terrestrial impacts. The Staff is not consistent in assuming that the coal gasification plant will or will not be built (see page L-16, ¶ 5). On page L-17, if both population densities are "reasonably low," what is the point at which one might be preferable over another? Under the Staff's analysis, as long as the Clinch River site meets the population criteria, no other site, no matter how remote, can ever be considered sufficiently preferable to be selected instead. This approach makes a mockery of the alternative site analysis.

NRDC-136

A conclusion about the environmental preferability of Murphy Hill is conspicuously absent from the DES. It appears that any reasonable balancing of the above-mentioned factors, whether or not the coal gasification plant is built, would lead to a finding that the site is substantially preferable.

SECTION 1.3, Phipps Bend

NRDC-137

This section must be substantially rewritten now that TVA has cancelled construction of the Phipps Bend reactors.

In this section, the Staff relies on NPDES Permit controls to eliminate potential aquatic impacts during low flow conditions. Yet, as noted above, these permit conditions are not designed to ensure no adverse aquatic impacts, and indeed require only that impacts be minimal (which is not defined). Again, meteorology is summarily deemed equivalent, when actually no adequate analysis of meteorological conditions at any TVA site has been performed. The Staff, as with Murphy Hill, does not explain the significance of an estimated 3,000-person difference in the available labor pool. The population density is lower here, and should operate to increase this site's preferability.

On page L-24, the Staff identifies chlorine and acetaldehyde as toxic materials transported near the site that would require reactor control room protection. The Staff does not identify the amount of such materials transported, the type

of protection needed, the cost of such protection, and the weight to be given this factor in evaluating the Phipps Bend site.

NRDC-137

SECTION 1.4, Yellow Creek

The Staff must reassess its analysis of the Yellow Creek site, since one of the planned TVA LWR units at this site has now been deferred. Of particular importance is a reassessment of socioeconomic effects and construction impacts. Again, the discussion of meteorology is unfavorable, for reasons stated above in relation to Murphy Hill and Phipps Bend. No endangered aquatic species appear to be present in Yellow Creek or Pickwick Lake, giving the site a substantial advantage. Comparing the "inconsequential impact to aquatic biota inhabiting Pickwick Lake," the existence of the proposed NPDES Permit conditions for the Clinch River site are insufficient to render the Clinch River aquatic impacts "comparable" to those at the obviously superior Yellow Creek site.

NRDC-138

SECTION 1.4.4.2, Terrestrial Resources

The Yellow Creek site must now be considered preferable in terms of impacts to terrestrial resources, because of the LWR unit deferral.

SECTION 1.4.5, Socioeconomics

NRDC-138

The Staff's conclusion that Yellow Creek socioeconomic impacts are less desirable than Clinch River must also be reconsidered because TVA plant deferral may alter socioeconomic factors in a manner not yet determined by the Staff. Could LMFBR demonstration plant location at Yellow Creek have a positive effect on the local economy through employment of workers who have been laid off from TVA plant deferrals? This entire section must be redrafted.

SECTION 1.4.6, Population

The Staff characterizes the Yellow Creek population density as "somewhat lower" than Clinch River. A fairer description would be that the Yellow Creek population density is "significantly lower."

NRDC-139

In general, all the TVA sites considered in Appendix L are preferable to the Clinch River site in terms of population density. Three of the sites, Yellow Creek, Murphy Hill, and Hartsville, are significantly lower in population density, and any objective analysis would find these sites substantially preferable under this factor. The Staff has treated the upper limit on population density as an acceptable level, and has failed to properly assess the real risk of the high Clinch River population density as opposed to the low population density at these three sites.

Second, the meteorology of the TVA sites, as with the Clinch River site, is analyzed in a wholly inadequate manner, using minimal, outdated, or speculative data. Thus, no meaningful comparison can be made between these sites and the Clinch River sites for this extremely important parameter. NROC-140

For all TVA sites, the Staff cannot accurately compare the labor pools at Clinch River with those available at sites with existing operating reactors, planned construction, or deferred or cancelled LWR reactors. The socioeconomic effects of cancellation or deferral of construction has not been assessed, and these effects must be included for plants presently or potentially deferred or cancelled. NROC-141

Regarding aquatic ecology, the Staff bases its conclusions upon the existence of NPDES permit conditions which are both inadequate and misstated in the FES. The Staff completely ignores the threat to several Federal endangered mussel species in the Clinch River, including Lampsilis orbiculata orbiculata, and to the state threatened species Cycleptus elongatus. The Staff's boilerplate analysis of the threat to aquatic ecology at the Clinch River site can in no way be deemed adequate. NROC-142

Additionally, terrestrial ecology is given an inadequate treatment in this comparison of alternative TVA sites. The Staff ignores the potential impacts at the Clinch River site to the endangered bald eagle and to four other state threatened or endangered species. NROC-143

SECTION 2, DOE Sites

SECTION 2.1, Hanford

SECTION 2.1.1, Geology and Seismology

NRDC-144

The Staff has not provided enough information to demonstrate whether in fact the current tectonic regime at the Hanford site is uncertain, what additional information is necessary, and what the costs would be of these additional studies. It is almost beyond belief that DOE and private utilites would have located so many nuclear reactors on the Hanford Reservation, including the Fast Flux Test Facility, without a thorough knowledge of the area's earthquake potential.

SECTION 2.1.2, Hydrology

NRDC-145

As the Staff concludes, the Hanford site is "more favorable than the Clinch River site" with regard to hydrology. The radioactive effluent diffusion and population served downstream are dramatically superior at Hanford, by a factor of 10. Given the potential radiological effects on downstream users, hydrology should be weighted heavily as a siting factor.

SECTION 2.1.2.1, Water Quality

NRDC-146

The Columbia River provides significant environmental advantage in water quality over the Clinch River. Yet the Staff ignores the substantially higher dilution rate by baldly

stating that "the apparent advantage does not weigh heavily in selecting among the alternatives," because the Staff has found no "significant" impacts on other Clinch River uses from the breeder plant. Here, as throughout the alternative sites analysis, the Staff avoids its duty to determine whether sites are significantly preferable. Under the Staff's approach, for example, as long as the Clinch River site meets minimum standards for hydrology, the degree to which another site has preferable hydrology can never be found significant. NRDC-146 NRDC-147

Even by this convoluted analysis, the Staff concluded that the Hanford meteorology is preferable, and that lower meteorological licensing costs would be required, compared to the Clinch River site. In particular, atmospheric diffusion is considerably better and the potential risks from tornadoes is substantially less. These factors should dictate a finding of "substantially preferable" rather than merely "preferable."

SECTION 2.1.4.1, Aquatic Ecology

NRDC-148

There are no federally or state recognized threatened or endangered aquatic species at Hanford. Hanford is environmentally preferable regarding construction impacts, and other impacts are at a minimum "comparable" to the Clinch River site, according to the Staff. However, as noted above, the Staff's assessment of the Clinch River potential impact on striped bass is inadequate. Even if the striped bass

NRDC-148 assessment were adequate, a fair summation of the relative aquatic ecology impacts would show Hanford to be substantially preferable. Thus, the Staff's conclusion of "comparability" is wholly unjustified.

SECTION 2.1.5, Socioeconomics

NRDC-149 The Staff's finding that the Hanford site is less desirable with regard to socioeconomic factors appears to be based almost solely on the smaller estimated labor pool at Hanford. This section must be rewritten and the conclusion reevaluated based on the changes in labor pool availability arising from the deferral of several WPPSS units nearby.

SECTION 2.1.6, Population

NRDC-150 Although the Staff characterizes the difference in population density between Hanford and Clinch River as "somewhat lower" these differences are in fact dramatic, as shown in Attachment A.

Again, the Staff fails to recognize a substantial difference when it sees one.

SECTION 2.2, Idaho National Engineering Laboratory (INEL)

SECTION 2.2.1, Geology and Seismology

NRDC-151

Although geology and seismology factors are considered less suitable at INEL than at Clinch River because a somewhat higher cost design may be necessary to protect against earthquakes, the Staff does not provide any estimates of what those higher costs would be. Furthermore, the difference in earthquake design costs is based on the assumption that a 0.25g earthquake ground acceleration is appropriate at the Clinch River site. Yet in the DES, the Staff now admits that it will not select the appropriate safe shutdown earthquake until after it issues its Safety Evaluation Report. The assumption of any cost difference is therefore invalid at this point.

SECTION 2.2.3, Meteorology

NRDC-152

As with Hanford, the meteorology at INEL is vastly superior, but has been substantially underrated by the Staff.

SECTION 2.2.4.2, Terrestrial Resources and Land Use

NRDC-153

The Staff's conclusion should be based on a thorough review of all available data and other "reconnaissance level information", rather than on the Staff's opinion. Given the paucity of important or unique terrestrial features at the INEL

NRDC-153 site which could be impacted by the LMFBR plant, there is no rational basis for the Staff's finding of "slightly preferable" rather than "substantially" preferable.

SECTION 2.2.5, Socioeconomics

NRDC-154 In comparing five socioeconomic factors, the Staff finds INEL preferable in two factors (historical/archeological and visual intrusion); comparable in two factors (residential and highways) and less preferable in only one factor (labor pool). Adding up those subfactors, it appears that INEL socioeconomic factors are preferable than Clinch River. The Staff's conclusion that Clinch River would have preferable socioeconomic impacts appears to result from attaching great weight to the size of the available labor pool. The Staff should explain the relative weights it attached to each of these socioeconomic factors in reaching its conclusion. Unless it does so, the INEL site should be considered preferable for this factor.

SECTION 2.2.6, Population Density

NRDC-155 As shown by the figures given, the Staff's conclusion that the INEL population density is only "somewhat" lower than the Clinch River site but is not environmentally preferable is shocking. See Attachment A.

SECTION 2.3, Savannah River

SECTION 2.3.2, Hydrology

NRDC-156

The Staff's failure to evaluate potential drinking water contamination outside the 50-mile zone is unreasonable. NEPA requires discussion of all reasonably foreseeable impacts, and if such contamination could occur beyond 50 miles, the use of an artificial cutoff line is arbitrary.

The Staff's statement that "[t]ransport of accidental radioactivity through the ground to the Savannah River would probably not be a problem" appears conclusory and speculative. If this conclusion is based upon actual data or analysis, the Staff should explain the basis for its conclusion.

SECTION 2.3.2.1, Water Quality

NRDC-157

The Staff has used a superficial analysis to arrive at an initial finding of Savannah River's preferability in water quality, but negated this initial finding by asserting that the Clinch River site meets minimal water quality standards. Both parts of this analysis are inadequate.

SECTION 2.3.3, Meteorology

NRDC-158

The Savannah River site is characterized as "slightly better" in meteorological terms, but the discussion is inadequate, since the data relied upon by the Staff is not specified, and the relative weights assigned to X/Q values and tornado risks are not disclosed.

NRDC-159 SECTION 2.3.4.1, Aquatic Ecology

The Staff does not explain why the endangered American alligator and the shortnosed sturgeon are not likely to be affected significantly by construction and operation of the breeder plant at the Savannah River site. The discussion of Clinch River striped bass impacts is inadequate for reasons stated above.

NRDC-160 SECTION 2.3.4.2, Terrestrial Resources

The discussion of terrestrial impacts is conclusory, lacks sufficient detail and analysis, and does not sufficiently support the Staff's conclusion of "no significant advantage" over the Clinch River site.

NRDC-161 SECTION 2.3.5, Socioeconomics

As with the Hanford socioeconomic discussion, the Staff should explain the relative weights it attaches to various socioeconomic factors in order to reach its finding of "comparability." Without such a ranking, the Savannah River site should be considered overally preferable, since it is preferable in two factors (highways and visual intrusion), and less preferable in only one factor (size of available labor pool).

SECTION 2.3.6 Population

NRDC-162

As shown in the chart below, the 1980 population density for Savannah River at any distance up to 30 miles is less than half that of the Clinch River site, yet the Staff arbitrarily characterizes this difference as only "somewhat lower." The Staff should admit the obvious, that the Savannah River site population is substantially preferable.

CONCLUSION

NRDC-163

The Staff concludes that all of the alternative sites are "probably" acceptable as nuclear power plant sites but that none are substantially better. First, the Staff should explain what it means by "probably" acceptable. Second, given the fact that many of the Staff's subconclusions regarding preferability are unsupported by the DES data itself, the overall conclusion that no sites are substantially better than the Clinch River site is similarly unsupported.

Tables L.1, L.2

NRDC-164

These tables represent little more than the Staff's method of presenting its conclusions about alternative sites. No meaningful parameters or numbers are included so that they can be compared. This arguably suits a "substantially better" test, but the other side of the argument is that a test involving broad discretion, like the "substantially better"

NRDC-164 test, should rest as much as possible on reasonable data, not conclusory assertions. The Staff is going through the motions here, but hasn't really told us anything, except that they prefer the Clinch River site. Table L.2 does indicate that Murphy Hill and Yellow Creek, by the Staff's own analysis, would not cost any more for safety measures.

NRDC COMMENTS - ATTACHMENT A

TOTAL POPULATION AND POPULATION DENSITY

CRBRP SITE*				HANFORD SITE			IDAHO (INEL) SITE		
1980				1980			1980		
Distance from site (mi)	Total population	Density (persons/ mi ²)	Distance from site (mi)	Total population	Density (persons/ mi ²)	Distance from site (mi)	Total population	Density (persons/ mi ²)	Distance from site (mi)
0-5	5,713	73	0 - 5	0	0	0 - 5	0	0	0
0-10	56,570	180	0 - 10	13,924	44	0 - 10	0	0	0
0-20	269,870	167	0 - 20	87,283	69	0 - 20	5,272	4	4
0-30	521,070	184	0 - 30	133,379	47	0 - 30	77,735	27	27

*Includes transient population for 0-10 miles.

NROC-165

TEN



State of Tennessee

LAMAR ALEXANDER GOVERNOR

September 13, 1982

United States Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Director,
Clinch River Breeder Reactor Program Office

Re: Comments on Draft Supplement to Final
Environmental Statement Related to
Construction and Operation of Clinch River
Breeder Reactor Plant. Docket No. 50-537

Gentlemen:

TEN-1
The State of Tennessee is presently participating in the licensing proceedings for the Clinch River Breeder Reactor Plant as an "interested state" pursuant to the provisions of 10 C. F. R., Section 2.715. The State of Tennessee hereby comments on the Draft Supplement to the Final Environmental Statement in this matter as follows. The Draft Supplement has been reviewed and we suggest that the Applicants make adjustments to socio-economic impact sections, particularly as they pertain to monitoring and mitigation actions which the Applicants will take to mitigate the effects the proposed construction will have on local community facilities and public services.

We note that the Applicants commit themselves to an ongoing monitoring process throughout the construction phase to determine if projections of impact and conclusions regarding cost of public facilities and services are occurring as anticipated. Experience with previous large-scale construction projects such as the Clinch River Plant leads us to conclude that impact projections and cost-revenue data such as contained in the subject Draft may be subject to change and that the need for a specific mitigating action may not present itself until actual "inmover" and construction processes begin.

TEN-1

We concur that such a monitoring-mitigation process is an appropriate mechanism for evaluation of impact change; however, we are concerned that the process as described in the Draft Supplement appears to be internal to the Applicants' management activities and does not explicitly define the process as one involving a participatory role for State and local governments. Therefore, we feel that it is advisable that the Applicants provide for a formal monitoring and mitigation process with a definite participatory role for local governments and appropriate State agency representatives.

The "Staff Evaluation" section at page 4-28 of the Draft Supplement contains a recommendation for a monitoring and mitigation process and we suggest that the Applicants incorporate the staff recommendation with those contained herein as a specific element of mitigation activity. We further suggest that any mitigation proposals which may be developed by the Applicants or NRC be subject to the formal mitigation process we have proposed above.

Sincerely,



Lamar Alexander

LA:ab

cc: William M. Leech, Jr.
Attorney General and Reporter

William C. Koch, Jr.
Counsel to the Governor

John L. Parish, Commissioner
Department of Economic and Community Development

Ted Von Cannon
Special Assistant to the Commissioner

Stephen Norris, Director
Tennessee State Planning Office

GF

JOHN R. MYER
ROBERT H. STROUP
GARY FLACK

ATTORNEYS AT LAW

1515 HEALEY BUILDING
87 FORBYTH ST., N. W.
ATLANTA, GEORGIA 30303
404/522-1934

September 13, 1982

U. S. Nuclear Regulatory Commission
Attention: Paul H. Leech, Director
Clinch River Breeder Reactor Program
Washington, D. C. 20555

Re: Draft Supplement to Final Environmental Impact Statement
For Clinch River. Document No. 50-537

Dear Mr. Leech:

GF-1

As a member of Georgians Against Nuclear Energy and as an individual, I am dismayed by the Draft Supplement to the Final Environmental Statement relating to Clinch River. Section 10.2.4.5 is an inadequate consideration of the estimated costs of decommissioning. The Bectel Corporation has done studies for decommissioning that were seemingly not considered in preparing this section. The studies to which I have reference were submitted to the Georgia Public Service Commission approximately two years ago. I would be glad to provide them to you if you have difficulty obtaining them. These studies indicate much greater costs than the above section estimates. I believe it is misleading to use 1978 dollars in this section.

GF-2

These same concerns apply in general to the entire cost benefit analysis of Chapter 10. The cost benefit analysis does not adequately address the costs of testing, delays and mistakes that occur in the operation of reactors. Specifically, the recent problems at the Savannah plant reflect costs that have been unanticipated by the government. The Savannah River Plant has seemingly caused higher incidences of rare radiation-caused disease in and around the Savannah River Plant; the plant now anticipates releasing radioactivity into the Savannah River in order to restart certain reactors; and the Savannah River Plant authorities now admit that the plant is unexpectedly causing the accumulation of hazardous substances in the ground under the plant. The point is that these costs were unanticipated. I believe there must be similar allowance for "unanticipated" costs that the Environmental Impact Statement has failed to do.

My comments relate to Chapter 10. By my silence, I do not intend

U. S. Nuclear Regulatory Commission
September 13, 1982

Page Two

to reflect general approval of the remaining sections or of the advisability of the project itself. I appreciate this opportunity to make these comments, however.

Very truly yours,

A handwritten signature in cursive script that reads "Gary Flack".

Gary Flack

GF/1

OAG

State of Tennessee



WILLIAM M. LEECH, JR.
ATTORNEY GENERAL & REPORTER

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MICHAEL E. TERRY

September 13, 1982

United States Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Director,
Clinch River Breeder Reactor Program Office

Re: Comments on Draft Supplement to Final
Environmental Statement Related to
Construction and Operation of Clinch River
Breeder Reactor Plant. Docket No. 50-537.

Gentlemen:

The State of Tennessee is presently participating in the licensing proceedings for the Clinch River Breeder Reactor Plant as an "interested state" pursuant to the provisions of 10 C.F.R. § 2.715. The Attorney General of the State of Tennessee, on behalf of the State of Tennessee, hereby comments on the Draft Supplement to the Final Environmental Statement in this matter as follows. The Draft Supplement has been reviewed and we suggest that the Applicants make adjustments to socio-economic impact sections, particularly as they pertain to monitoring and mitigation actions which the Applicants will take to mitigate the effects the proposed construction will have on local community facilities and public services.

We note that the Applicants commit themselves to an ongoing monitoring process throughout the construction phase to determine if projections of impact and conclusions regarding cost of public facilities and services are occurring as anticipated. Experience with previous large-scale construction projects such as the Clinch River Plant leads us to conclude that impact projections and cost-revenue data such as contained in the subject Draft may be

OAG-1

subject to change and that the need for a specific mitigating action may not present itself until actual "inmover" and construction processes begin.

0A6-1

We concur that such a monitoring-mitigation process is an appropriate mechanism for evaluation of impact change; however, we are concerned that the process as described in the Draft Supplement appears to be internal to the Applicants' management activities and does not explicitly define the process as one involving a participatory role for State and local governments. Therefore, we feel that it is advisable that the Applicants provide for a formal monitoring and mitigation process with a definite participatory role for local governments and appropriate State agency representatives.

The Attorney General is especially concerned over the Applicants' failure to address the socio-economic effects of a possible mid-construction project shutdown or other premature plant closure. The construction phase of the Clinch River Plant is scheduled to last for a seven-year period. (Draft Supplement § 4.1). In addition, it has been assumed that the Plant will have a thirty-year operational life. (Draft Supplement Summary and Conclusions at iii). The influx of personnel and commerce and the resulting socio-economic effects on the impacted area will be significant, especially during the construction phase of the project. Should this project be cancelled or terminated during the construction phase of the project, the Attorney General fears that the harmful effects of such premature project closure may be significant.

0A6-2


However, the Draft Supplement is wholly lacking of any discussion or analysis of the effects of such premature closure. The Attorney General believes the history of this project shows that such an eventuality is not and should not be relegated to mere speculation but is a very possible scenario which should be addressed. In addition, the Attorney General feels that any program developed to monitor and address the mitigation of adverse socio-economic impacts should include the impacts of premature plant closure.

The "Staff Evaluation" section at page 4-28 of the Draft Supplement contains a recommendation for a monitoring and mitigation process and we suggest that the Applicants

OAG-2

incorporate the staff recommendation with those contained herein as a specific element of mitigation activity. We further suggest that any mitigation proposals which may be developed by the Applicants or NRC be subject to the formal mitigation process we have proposed above.

Sincerely,


WILLIAM M. LEECH, JR.
Attorney General

WML:mjf

cc: William C. Koch, Jr.
Counsel to the Governor

Ted Von Cannon
Deputy Commissioner,
Tennessee Department of Economic
and Community Development

Stephen Norris, Director
Tennessee State Planning Office

Don Waller
Tennessee State Planning Office

Service List



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET
ATLANTA, GEORGIA 30365

4PM-EA/SNM

EPA

SEP 13 1982

Mr. Paul H. Leech
CRBR Program Office
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Paul:

The Environmental Protection Agency has reviewed the U.S. Nuclear Regulatory Commission's Draft Supplement to Final Environmental Statement (DSFES), issued July 1982, related to the construction and operation of the Clinch River Breeder Reactor Plant. Since EPA has declared the CRBRP a "new source" in terms of the Clean Water Act, we have had the opportunity to work very closely with you and your staff during the preparation of this document. Thank you for the excellent spirit of cooperation that you have extended to EPA. I congratulate you on the fine job of incorporating the NPDES Permit requirements and the EPA views into the DSFES.

EPA-1

We have identified some areas where we feel that additional information and minor changes are needed. A list of specific comments is attached. Hopefully, the issue of the Federally protected Lampsilis O. orbiculata, pink mucket pearly mussel, will be solved prior to issuance of the Final supplement. It is our understanding that the U.S. Fish and Wildlife Service, Asheville, North Carolina, Office is reviewing the report submitted in August 1982.

EPA-2

EPA commends NRC for the inclusion in Section 11.7.16, Emergency Preparedness Plans of NUREG-0654/FEMA-REP 1 "Criteria for Preparation and Evaluation of Radiological Response Plans and Preparedness in Support of Nuclear Power Plants" Revision 1, Nov 1980. These additional requirements for the CRBRP should provide reasonable assurance that protective measures can and will be taken both onsite and offsite in behalf of public health and safety.

EPA-3

The Draft Supplement states that no changes have been made regarding sodium behavior. It is believed that test data involving sodium releases to the atmosphere have shown that sodium aerosols tend to form agglomerates that fall out rapidly. Additional information is needed to establish quantitatively the effect of this mechanism on subsequent downwind exposure to sodium.

EPA-4

The Final Supplement should clarify the intended period of operation for the CRBRP covered by the NRC construction permit. Is the intended NRC licensing period for the five years (DOE demonstration plant) that TVA will manage and operate the plant or is the licensing period to be the nominal 30-year life of plant as used in Light Water Reactor (LWR) licensing? It is realized that technical specifications for operation could vary over the life of the plant necessitating revised source release terms for liquid and atmospheric effluents. The specification of the source release term may be the largest single source of uncertainty in the radiological assessment calculations, especially for short-term releases. An estimate of the core fuel composition and magnitude of various postulated releases from CRBRP is needed to establish a radiological envelope for operation of the plant over the 30-year period (see Page iii). (Note - The example of the Shippingport Reactor with various core configurations throughout its operational life.)

After a thorough review of the document and the project, we have assigned a rating of LO-2. EPA has no objection to the project as presented; however, some additional information is needed. We look forward to a continued cooperative effort through the issuance of the FSES.

Sincerely yours,



Sheppard N. Moore, Chief
Environmental Review Section
Environmental Assessment Branch

Enclosure

SPECIFIC COMMENTS

1. Page 1-2, Item 15. 401 certification of the NPDES permit was issued by the State of Tennessee on July 15, 1982, and is virtually unchanged from the draft certification dated June 9, 1982. A copy will be provided for inclusion in the FSES.

EPA-5

2. Page 2-6, Section 2.5.3, second and third paragraphs. The applicant has committed that (1) there will be no spoil disposal areas within the 100-year floodplain and (2) all treatment ponds except Pond C (NPDES 005) will be removed after completion of construction.

EPA-6

3. Page 3-6, Figure A3.4. Cooling tower blowdown should be designated as "(011)*". Metal Cleaning Waste Discharge (012)* should be added.

EPA-7

4. Page 3-16, Section 3.6.2. NPDES number should be 011 rather than 010.

EPA-8

5. Page 3-18.

a. Section 3.6.5. Heading and text should address this waste source as Metal Cleaning Waste rather than Chemical Cleaning Waste.

EPA-9

b. Section 3.6.9. Only Treatment Pond C (NPDES 005) will remain after completion of construction.

EPA-10

6. Page 3-19. In accordance with the 401 certification issued by the State of Tennessee on July 15, 1982, the following changes should be made to the "Permit Limit" column of Table A3.3:

EPA-11

- | | |
|--|------|
| (a) Residual Chlorine | 2.0* |
| (b) Ammonia Nitrogen (N) | - - |
| (No ammonia nitrogen limitation was found to be necessary for this discharge.) | |

7. Page 4-6, last paragraph and Page 5-6*, Section 6.1.4.1. An Erosion and Sediment Control Plan, dated July 16, 1982, with revisions dated July 28, 1982, has been approved by EPA Region IV. The word "turbidity" in the third line of the second full paragraph of Section 6.1.4.1 should be, in our opinion, replaced with "total suspended solids".

EPA-12

*Page number should have been 6-12.

EPA-13

8. Pages 4-6 to 4-7. The authors conclude "no significant impact from construction" to the pink mucket pearly mussel. There is no prior discussion of how the construction activities or the Erosion and Sediment Control Plan affects this species. The dredging for the loading facilities could potentially affect the mussel. Also, page 2-19, a study is cited which estimates the population of the pink mucket pearly mussel in the vicinity to be 1 to 211 individuals. At Pages 5-6 to 5-7, a survey is briefly described, but the DSES is still inconclusive on how the L. O. orbiculata can be protected or will not be adversely affected. Terms such as "preliminary analysis" and "tentatively concluded" lead one to believe that the effect of the construction on the species is still quite unclear. (See also 10.1.2.2 which ignores the discovery of L. O. orbiculata, but does say benthic habitat would be disturbed.)

EPA-14

9. Page 5-6, Section 5.3.2.2. Some minor changes need to be made to the last paragraph of this section so that language reflects the permit conditions.

EPA-15

10. Page 6-8, Figure A6.3. There is an error in the Figure A6.3. It shows CRM15 at transact 5 at the top of the page and again CRM15 at transact 4 in the middle of the page.

EPA-16

11. Pages 10-4 through 10-8, Section 10.2.4. Decommissioning is addressed, but a "deep geologic disposal facility" is mentioned as possibly necessary in the future. No other mention is made with respect to cost, availability, feasibility, or environmental impact of such a facility. This seems clearly to be a secondary impact.

EPA-17

12. Page 11-9. It is noted in Section 11.4.10 Disposal of Dredged Material that the amount of dredged material estimated for disposal has been further reduced from 20,000 m³ to 8,500 m³ as a result of the redesign of the barge unloading facility. It is recommended that Section 4.6 Measures and Controls to Limit Adverse Effect During Construction should include provisions that the Clinch River dredged sediments containing radioactive material be placed in a spoil storage area above floodplain level and that an adequate surveillance program, including radiological monitoring, be established for these dredged sediments.

EPA-18

13. Page 11-9, Section 11.7.13. Regarding Sodium Behavior, it is stated that no changes have been made to this section. It is believed that sodium releases to the atmosphere have shown that sodium aerosols tend to form agglomerates that fall out rapidly. Additional information is needed to establish quantitatively the effect of this mechanism on subsequent downwind exposure to sodium.

14. Page D-2, Appendix D. In the Environmental Effects of the CRBR Fuel Cycle and Transportation of Radioactive Materials, Section D.1, it is stated that the average annual CRBRP fuel requirements for plant operation after equilibrium has been reached were developed from DOE CRBRP data bases for the NRC staff by ORNL (NRC 1982a). These values reflect only the initial fuel core loading and its equilibrium fuel cycle. Bounded values of the fuel core loading characteristics, including isotopic radionuclide content, estimated failed fuel release parameters are needed to establish a radiological envelope for operation of the plant over the 30-year life of plant and to provide the information to summarize population annual doses over this period.

CWE

THOMAS AND HAIR

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TELEPHONE
(215) 821-8100

September 9, 1982

Office of the Director
Clinch River Breeder Reactor Program Office
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Re: Comments on Draft Supplement to Final Environmental
Statement for the Clinch River Breeder Reactor Plant
(NUREG-0139, Supp. No. 1)

Gentlemen:

By letter of June 10, 1982, to the Commission, I commented concerning the need for supplementation of the 1977 FES, and requested, for purposes of comment, a copy of any Draft Supplement to the FES issued. On June 29, 1982, Mr. Check, Director of the CRBR Program Office, forwarded to me a letter stating that a copy of the report would be sent to me "when it becomes available".

Despite the notice of availability appearing in the July 30, 1982, Federal Register, and a number of follow-up telephone calls placed by me in an effort to secure a copy of the Draft Supplement to the FES, I did not receive a copy until the afternoon of September 8, 1982, only 2 working days prior to expiration of the comment period.

I renew the request for additional time to comment, which I made by letter of September 2 to the CRBR Program Office.

However, in an effort to comment within the period established by the July 30, 1982 Federal Register notice, I wish to make the following preliminary observations regarding the Supplement to the CRBR FES.

CO02

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PDR ADOCK 05000537
D PDR

Impact of Emergency Planning Measures

CWE-1

Section 11.7.16, discusses in response to earlier comments, a highly generalized treatment of emergency planning, the recent changes in the Commission's emergency planning regulations. The discussion of those measures, even as supplemented by Appendix J, fails to include any discussion of the "socioeconomic impacts . . . associated with emergency measures during or following an accident". Such a discussion in environmental statements is required by the Commission's Statement of Interim Policy re: Nuclear Power Plant Accident Considerations Under NEPA of 1969, 45 Fed. Reg. 40101. See particularly p. 40103.

The omission of some treatment of the socioeconomic impacts associated with emergency measures is in the face of the explicit recognition in the FES Supplement of the types of protective actions which may be warranted, including evacuation and interdiction of food stuffs and land. See FES Supplement, p. J-15. Such measures will necessarily entail socioeconomic cost. If the reference in Table J-5 to the "cost of protective actions and decontamination" purports to be a response to the Interim Policy Statement requirement of discussion of socioeconomic impacts, it is woefully inadequate. A single dollar figure purporting to be an "average" value of "cost" of protective actions and decontamination due to "selected" CRBRP accidents is not the discussion which the interim policy statement contemplated. The socioeconomic impact of interdicted land and food for uncertain periods of time has not been included in the "cost" of taking protective action.

Thus, while "the results shown for CRBRP include the benefits of these protective action", (P. J-15) the FES has not factored in the total cost of the emergency measures.

Among, but certainly not an all-inclusive list of, the socioeconomic impacts of emergency measures which must be analyzed are the following:

- (1) loss of property value due to interdiction, including depreciation in market value, and lack of maintenance-caused depreciation if interdiction extends for a long period;
- (2) loss of revenues from income-producing property which has been interdicted;
- (3) loss of revenues resulting from evacuation;
- (4) social impact of disruption of local economy and social fabric caused by evacuation;

CWE-1

(5) relocation costs;

(6) impact of interdiction or evacuation of nearby facilities with implications for national energy and security, (e.g., the Oak Ridge Gaseous Diffusion Plant, the ORNL R & D facilities, the DOE Y-12 area).¹

Radiological Impact on Biota

CWE-2

My review of the Supplement to the FES discloses no discussion of the consequences of potential radiological exposure to biota caused by accidents as required by the Statement of Interim Policy. See 45 Fed. Reg. 40103. The only discussion in the FES of radiological impact on biota appears to be that found in the FES, § 5.7.1, and supplement, P. 5-10, and is limited to exposures resulting from "routine" operation. Thus, the Statement of Interim Policy has not been complied with in this regard.

Probabilistic Treatment of Accidents

CWE-3

The Supplement (P. J-18) notes that a PRA will be performed for the CRBRP, reviewed by the Staff, and discussed in the SER. The Statement of Interim Policy notes that

The environmental consequences of releases whose probability of occurrence has been estimated shall also be discussed in probabilistic terms.

The Staff should therefore commit to issuance of another supplement to the FES upon review of the PRA, for purposes of including in the FES a fuller discussion of the full range of consequences of accidents analyzed in the PRA, together with their associated probabilities.

In the interim, however, I see no reason why estimated accident consequence probability distribution figures cannot be generated by the CRBR as they have been for LWRs and disclosed as they are now routinely done in Environmental Statements for purposes of licensing LWRs. See, e.g., NUREG-0654, Supp. No. 2, Supplement to Draft Environmental Statement - Susquehanna Steam Electric Station, Units One and Two, pp. 6-29 to 6-33. However, such figures should be generated for all accident consequences, including early injuries, leukemias,

Office of Nuclear Reactor Regulation
Page 4
September 9, 1982

interdicted area, decontamination cost, interdicted crop cost, interdicted population, etc. This is a serious omission in the FES.²

CWE-3

Uncertainties

While the Supplement generally addresses the issue of "uncertainty" with respect to the environmental consequences of CRBR accidents (pp. J 18 - J 19) it does so in a meaningless way. The range of uncertainty of consequences would far better be expressed by generation of CCDF figures of merit, in order to disclose the actual quantifiable range of consequences and their associated probabilities, and with uncertainty bands. Where "actual" figures are disclosed (e.g. Table J-5) only "average" values are used. This does not properly disclose the uncertainties of the figures used. In addition, appropriate discussion of uncertainties in specific areas (e.g. health effects models) was absent.

CWE-4

The opportunity afforded to me to express my views was extremely limited, because of the failure of the Commission to timely provide a copy of the draft Supplement. However, I appreciate the opportunity, albeit limited, and I look forward to receiving a hopefully much improved final supplement to the FES.

Very truly yours,


CHARLES W. ELLIOTT

CWE: seh

FOOTNOTES

¹The Supplement at p. 11-24 merely notes that because information is not "readily available", the Staff has "not evaluated the impacts of severe accidents on activities at the DOE-controlled facilities." The lack of "readily available" information does not relieve the obligation to evaluate and disclose socioeconomic impacts. All the DOE facilities mentioned are within the 10 mile plume exposure EPZ, for which emergency plans must be established, which usually include evacuation as a protective measure.

CWE-1

²I understand that a CRAC-type computer run was performed for the CRBR site. Obviously, under the Statement of Interim Policy,

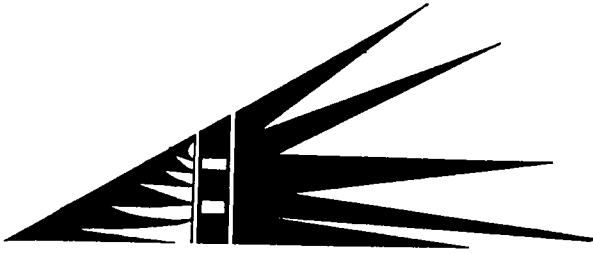
CWE-5

Office of Nuclear Reactor Regulation

Page 5

September 9, 1982

CWE-5 a disclosure of the consequence-output is required, and I fail to understand why it has been omitted. While some of this information may have appeared in the site-suitability report, its omission in the FES, the only document circulated for NEPA purposes, constitutes a failure to comply with NEPA.



SOUTHWEST RESEARCH AND INFORMATION CENTER

September 13, 1982

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
Attn: Director, Clinch River Breeder
Reactor Program Office

Dear Director:

Southwest Research & Information Center is submitting these comments on the NRC's Draft Supplement to the Final Environmental Statement on the CRBRP, Docket No. 50-537, NUREG-0139, Draft Supplement. We are an educational and scientific organization working primarily on energy and environmental issues. A number of our supporters live near the Clinch River site, and people across the nation are concerned about the impacts of the Breeder Program.

First, we want to strongly object to the procedures used in obtaining comments on this draft. Section 1506.10(c) of CEQ's NEPA regulations requires "not less than 45 days for comments on draft statements." NRC is giving only the minimum 45 days from the publication of the Federal Register notice, which in our case is only 31 days from the time of the actual receipt of the document. (This short availability to us is despite our request of June 9, 1982 that there be a supplement and that we receive the Supplement when it was prepared.) Additionally, we received the Errata Sheet for the supplement only 9 days prior to the comment deadline for the supplement. Thus, we have clearly been effectively denied the minimum requirement of a 45 day comment period. Thus, we would request an additional 15 day comment period from the time that we are notified that such a comment period is available. Because of the inadequate time given to us to comment on the document, these comments are admittedly less detailed than we would have otherwise prepared.

P.O. BOX 4524 ALBUQUERQUE NEW MEXICO 87106

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SRIC-1 Both the FES and the Supplement are grossly inadequate in discussing transportation issues. The Safe Secure Transport (SST) is not described in any adequate way for either NRC or the public to realistically evaluate its safety. The discussion of Type B packages on pages 7-3 to 7-5 and in Appendix D fails to mention that packaging for the wastes from the CRBR do not exist. Thus, the public putting faith in the assertion that the packages "are designed to withstand severe accident environments" is akin to saying that the DC-9 was designed to fly safely. Design and actual performance are not the same, especially regarding nuclear waste transportation where over the next 15 years the nation faces totally unprecedented numbers of shipments of commercial spent fuel and TRU wastes and of military high level and TRU wastes. A point that will also be emphasized later is that there is inadequate discussion of the origin of the initial fuel for CRBR, including its transportation to the site.

SRIC-2 A point of substantial concern to us and the public generally is the environmental and health consequences of releases of plutonium and other radioactive materials. Since several of the changes in the Errata Sheet deal with this issue, we are especially concerned about the ridiculously short comment period on this data. Suffice to say that there are clear inadequacies in the numbers given. Specifically, there is no indication that the Staff has considered the studies of Dr. E.A. Martell ("Basic Considerations in the Assessment of the Cancer Risks and Standards for Internal Alpha Emitters," Jan. 10, 1975, Statement at hearings by EPA on plutonium standards and, with S.E. Poet, "Plutonium-239 and Americium-241 Contamination in the Denver Area," Health Physics, Oct. 1972, pp. 537-548) and K.Z. Morgan ("Suggested Reduction

of Permissible Exposure to Plutonium and Other Transuranium Elements," SRIC-2
American Industrial Hygiene Association Journal, August 1975, pp. 567-575) on
acceptable levels of plutonium for workers or the public. There is no
adequate discussion of the impacts of Plutonium-238, Plutonium-241 and
Americium-241 on the biota, despite the fact that significant scientific
research shows that compounds of americium may be taken up by plants from the
soil more readily than plutonium (see, for example, John T. Edsall, "Toxicity
of plutonium and some other actinides," Bulletin of the Atomic Scientists,
Sept. 1976, pp. 27-37). Thus, while we have not had adequate time to arrive
at alternative calculations, we feel strongly that the doses mentioned in the
Supplement for releases of effluents from CRBRP facilities are not
conservative and that they could be understated by significant amounts.

Further, it is unclear how the doses in Tables A5.2 and A5.3 were in fact SRIC-3
arrived at. There is no indication of why the site boundary was changed from
"0.4 miles SSW" on page 5-22 of the FES to "0.44 miles NW" on page 5-12 of the
Supplement. Even more amazingly, page 5-23 of the FES indicated that
discharge "would be fully diluted by a factor of 670 over the unmixed plant
discharge;" while the Supplement (page 5-18) says the discharge "would be
fully diluted by a factor of 67 over the unmixed plant discharge." Are either
of these numbers correct? If so, how do we know it to be true? Why the great
change, which from our view has to have environmental impacts? Additionally,

Appendix D apparently does not even draw on existing data of dose releases SRIC-4
from the West Valley facility; data which are certainly relevant and
applicable to Clinch River. Uniform dispersion will not occur, so why is that
assumed? All of these omissions of other scientific data and analysis that is
known to NRC staff can only lead to the conclusion that they were
intentionally ignored--a totally unacceptable and inadequate discussion for a
FES or a Supplement.

SRIC-5 We find no adequate discussion of the cumulative and potentially synergistic effects of other activities in the nearby area. For example, we understand that a synfuels plant is to operate in the area. What are the impacts of the synfuels facility and the CRBR? Such analysis is necessary to adequately inform decision-makers on either project. Additionally, the impacts of dredging on the rivers in the area is mentioned on page 4-28 only in relation to fish spawning; however potential releases of radioactive materials that are not initially taken up by the biota are certainly possible and must be analyzed not only for the initial dredging (page 4-28) but also for that dredging necessary during the lifetime of the facility. There is no indication in the Supplement that an adequate, comprehensive study of these issues has been done.

SRIC-6 Regarding safeguards issues, we find no adequate discussion of possible theft of plutonium and especially no discussion of potential sabotage by terrorists. For both environmental and legal reasons such a discussion is necessary, and it should have been done in this Supplement if there is any possibility that such sabotage could take place.

Thank you for your consideration of these comments. We hope to hear from you soon regarding an extension of time for us and any other members of the public who were given inadequate time to comment on the Supplement.

Sincerely,

Don Hancock
Information Coordinator

CALIFORNIA ENERGY COMMISSION

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(916) 920-6815



September 20, 1982

U.S. Nuclear Regulatory Commission
Attention: Paul H. Leech, Director
Clinch River Breeder Reactor Program
Washington, DC 20555

Dear Mr. Leech:

Enclosed are the joint comments of the Governor's Office of the State of California and the California Energy Commission on the Draft Supplement to the Final Environmental Statement for the Clinch River Breeder Reactor Plant (Docket No. 50-537, NUREG-0139, Supplement No. 1, July 1982). Our review finds that the Supplement is not in compliance with the requirements of the National Environmental Policy Act (NEPA) and therefore should be withdrawn pending further revisions and comments.

We appreciate the one-week extension on filing comments that you were able to grant us due to the late receipt of our copy of the Draft Supplement. (Telephone conversation with Peter Gleick, Deputy Assistant to the Governor for Energy and Environment.) If you or your staff have any questions concerning our comments, please do not hesitate to contact us.

Sincerely,

A handwritten signature in dark ink, reading "Emilio E. Varanini, III".

EMILIO E. VARANINI, III
Commissioner and
Presiding Member
Nuclear Fuel Cycle Committee

EEV/DG/dr16B21

Encl.

COMMENTS OF THE STATE OF CALIFORNIA
GOVERNOR'S OFFICE AND CALIFORNIA ENERGY COMMISSION
ON THE DRAFT SUPPLEMENT TO THE
FINAL ENVIRONMENTAL IMPACT STATEMENT FOR
THE CLINCH RIVER BREEDER REACTOR PLANT

Introduction

The "Draft Supplement to Final Environmental Statement Related to Construction and Operation of Clinch River Breeder Reactor" (NUREG-0139, July 1982), hereinafter called the Supplement, fails adequately to update and supplement the original "Final Environmental Statement Related to Construction and Operation of Clinch River Breeder Reactor Plant" (NUREG-139, February 1977), hereinafter called the 1977 FES. Our comments below focus on those sections of the Supplement that are particularly inadequate and which should be redone.

The Supplement fails to update the operating experience gained by the numerous foreign breeder reactors. Such operating experience is extremely important to safe design, construction, and operation of the Clinch River Reactor. Foreign experience is also important in considering whether or not the purchase of foreign designs might be a more economic and timely alternative.

The Supplement fails to discuss adequately waste management issues, fails to give specific plans for handling CRBR high-level wastes, fails to discuss establishment of waste

facilities and final site selection, and omits any discussion of the ongoing waste confidence proceeding being conducted by the NRC. Similarly, the Supplement provides only a generic discussion of decommissioning issues, despite the significant environmental impacts that could result from decommissioning the CRBR.

Other problems include a continued reliance on inappropriate probabilistic risk estimates for accident evaluations and a wholly inadequate discussion of the probability and consequences of nuclear proliferation and sabotage.

The Supplement also fails to correct the original reliance of the 1977 FES on Table S-3, the use of which has been voided by the U.S. Court of Appeals for the District of Columbia Circuit.

The Supplement should be withdrawn because of these deficiencies and not re-released until the problems have been addressed and corrected.

The Discussion of Need for the Proposed Facility and
Alternatives is Still Inadequate and Out-of-Date

CEC-1

No changes or updates to Sections 8.4 and 9.1 of the original 1977 FES were made in the CRBRP Draft Supplement. These

CEC-1 sections in the original FES discussed the need for and alternatives to the proposed facility. As a result of new information the existing discussion in these sections is grossly inadequate and dated.

Although the NRC has ruled that discussion of alternatives to the CRBRP can be limited to alternative sites and alternative demonstration facilities that meet Liquid Metal Fast Breeder Reactor (LMFBR) informational goals, the discussion of these alternatives in the FES and the Supplement is neither current nor complete.

40 CFR 1502.14 requires that Environmental Impact Statements:

"...should present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision maker and the public. In this section agencies shall:

- (a) Rigorously explore and objectively evaluate all reasonable alternatives,...
- (b) Devote substantial treatment to each alternative considered in detail..."

Specifically, the FES must discuss:

- (1) the specific advantages, disadvantages, barriers to commercialization, and comparative costs of each competing breeder technology;
- (2) the comparative risks, reliability, safeguards, and proliferation aspects of each competing alternative; and
- (3) the status of commercial development of the competing technologies.

According to Table A8.1 (Supplement, p.8-3), ten fast breeder reactors worldwide are presently operable, including six loop- and four pool-type reactors. These reactors have amassed nearly 100 reactor-years of breeder reactor experience between them. This excludes the operating experience gained from another eight fast breeders already shut down.

Since 1977, breeder reactors have amassed an additional 42 reactor-years of experience since 1977--nearly half of the total experience of those reactors still in operation. The Supplement acknowledges this record when it states:

"The record of performance of the major breeder reactors has been extended considerably since the FES was issued... Experience gained from the operation of these foreign breeder reactors is providing useful information about their particular designs" (Draft Supplement, pp. 8-2,4).

Yet the analysis of the technical alternatives to the Clinch River design has not been updated from the 1977 version. Every alternative listed in Section 8.4 says, "No changes have been made to this section". Given the 42 reactor-years of experience gained, we find it difficult to believe that no new information relevant to alternative breeder designs has been amassed. We believe the foreign experience gained may be significant for both the design for the best U.S. demonstration breeder and the issue of whether or not foreign designs could be purchased directly, as an alternative to an expensive and time-consuming U.S. demonstration program.

CEC-2 Proliferation Risks and Diversion or Sabotage Risks are
Greater than Estimated in the Supplement

The discussion of the risks of the proliferation of nuclear weapons resulting from the expanded production and use of plutonium in the nuclear fuel-cycle is wholly inadequate. Similarly, the discussion of possible sabotage or diversion of weapons materials is inadequate in certain critical respects.

Nonproliferation. Section 8.4.7, an addition to the original 1977 FES, discusses very briefly the suitability of different breeder designs for safeguarding fuel materials against diversion to national or subnational weapons programs. The conclusion, based on the review done for the International Fuel Cycle Evaluation program (INFCE), is that

"none of the proposed alternatives was entirely suitable to meet the goals of the program...It is clear that the CRBR system, and fast reactors in general, can adopt different fuels and reprocessing schemes, so that if such variants are judged to be required, there is some flexibility for their accommodation." (Draft Supplement, pp. 8-5,6)

This conclusion is misleading. At issue is not whether the CRBR and fast reactors in general "can" adopt different fuels and reprocessing schemes, but rather whether the CRBR "as proposed" together with its associated fuel cycle facilities provide safeguards against diversion of nuclear weapons materials which

are superior to alternatives breeder designs. This issue is not addressed adequately by either the Supplement or the original 1977 FES.

In fact, evidence suggests that the CRBR is significantly worse than some of the alternative breeder designs. According to the Office of Technology Assessment (OTA), the LMFBR is extremely vulnerable to diversion--relative to other nuclear technologies, including breeder technologies--from facilities for reprocessing, reprocessed fuel fabrication, and the stockpile of excess strategic nuclear materials. On a scale from "A" (diversion resistant) to "F" (most vulnerable to diversion), the OTA gave the LMFBR an "F" for each of these fuel cycle activities, and gave a "D" for the fabrication and transport of fresh fuel and for the reactor itself. In contrast, OTA gave considerably higher marks to the Molten Salt Breeder Reactor--a design that should receive more attention for its proliferation-resistant characteristics. (Nuclear Proliferation Factbook, Committee on Governmental Affairs, U.S. Senate Committee on Foreign Affairs, September 1980, p. 334)

Diversions and Sabotage . The conclusion of Section 7.3--that "the risks associated with [successful theft, diversion, or sabotage] do not represent a significant increase over the risks associated with currently operating facilities" (Supplement, p. 7-6)--is unsupportable given the technical and political nature

CEC-2 of the breeder design and the materials involved.

Total "risk" is normally defined as the probability of an event occurring times the consequences of that event, summed over the entire range of possible events (Gleick and Holdren, "Assessing Environmental Risks of Energy" American Journal of Public Health September 1981). The technical characteristics of the breeder program, however, make the breeder particularly attractive to national or subnational groups seeking bomb-grade material, since large volumes of such materials would be in constant circulation. For this reason, the probability of diversion from the LMFBR would be considerably higher than the probability of diversion from existing facilities. Existing LWR facilities are relatively diversion-resistant because of the lack of reprocessing and the lack of readily-available strategic nuclear materials. Similarly, the consequences of such a diversion are equal to or greater than the consequences of diversion from existing facilities, since the materials diverted could be as easily or more easily converted into bomb-grade materials and fabricated into nuclear weapons.

The sum of probability times consequences for the diversion of materials from a breeder program--and thus the total risk--is higher than for existing nuclear facilities. For the same reason, the total risk for the single breeder discussed here, the Clinch River Breeder Reactor, is higher than the risk from

the any single reactor in the existing U.S. program.

CEC-2

The risk of sabotage is also likely to be considerably higher for the CRBRP than for existing facilities. The CRBRP is a program designed to advance the state of the art of knowledge about breeder reactors. For this reason, and because of the more dangerous nature of plutonium (both because of its chemical nature and its weapons potential), the breeder must be assumed to be a particularly attractive target. The recent attack on the SuperPhenix in France supports this view. In January 1982, five rockets were fired at the SuperPhenix, causing only minor damage, but narrowly missing twenty workers and a sodium depot (Los Angeles Times "Rockets Hit French Atom Plant Project", January 19, 1982). The risk of sabotage of the breeder or sabotage of fuel (either spent or fresh) during transportation can thus be assumed to be higher than projected by the Supplement.

Most important, however, there is evidence to suggest that safeguards at nuclear power plants are not satisfactory to meet even the NRC "design basis" threat (Supplement, p. E-3). Numerous incidents of sabotage by individuals inside and outside U.S. and foreign nuclear reactors are well documented (see Lovins and Lovins, Brittle Power , pp.141-156).

The most telling criticism of the adequacy of protecting nuclear

CEC-2 power plants from theft or sabotage is the recent disclosure that special teams of the Department of Energy were successful in infiltrating the U.S. Savannah River nuclear weapons plant, seizing hostages, and taking over the control room during a security test. This team used no force and found it to be relatively easy to enter the plutonium production reactor at Hanford, Washington as well (San Francisco Chronicle September 17, 1982, p.1). These disturbing incidents point strongly to the gross inadequacies of the security at even existing nuclear weapons plants.

CEC-3 Reliance on WASH-1400 Probabilities is Inappropriate

The continued reliance on WASH-1400 accident probabilities for the evaluation of the consequences of reactor accidents is inappropriate given the extensive criticisms of that report and its inappropriate treatment of the uncertainties involved in probabilistic risk assessment. Moreover, a new report by the U.S. Nuclear Regulatory Commission ("Precursors to Potential Severe Core Damage Accidents: 1969-1979 A Status Report", NUREG/CR-2497, June 1982) indicates that the actual probability of severe core damage accidents in existing reactors is considerably higher than theoretical estimates would suggest. If these new data are applicable to breeder reactors, they suggest that the Draft Supplement must reevaluate accident probabilities and consequences in light of new information

received since 1977. If such analyses are not applicable to breeder designs, then the reliance of the original FES on the WASH-1400 data is inappropriate and should be redone.

CEC-3
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The Supplement Fails to Adequately Assess Unresolved Waste Management Issues

Waste management is, of course, one of the most important aspects of any nuclear facility and one factor for the Clinch River Breeder Reactor Plant (CRBRP) and that needs to be thoroughly assessed under NEPA. DOE has identified waste management as one of the critical environmental impacts of the breeder reactor program. (Final EIS, Liquid Metal Fast Breeder Reactor, May 1982, DOE/EIS-0085-FS.) Unfortunately, as was the case with DOE's generic EIS, the NRC's discussion of waste management for the CRBRP is totally inadequate.

The Supplement concludes that CRBRP waste management requirements do not constitute a significant environmental impact (Supplement, p. D-24). Basically, the NRC staff identifies final site selection and "establishment" of facilities as the only unresolved issues in handling CRBRP wastes (Supplement, p. D-34) and gives no suggestion that there will be any difficulty at all in resolving these issues. Moreover, the Supplement does not even give any specific plans for handling CRBRP high-level wastes, stating only that they will be either buried or stored indefinitely on site (Supplement, p. 3-14), without indicating the differing impacts and problems between burial and on-site storage. The CRBRP waste management issue is considerably broader than simply a current lack of identification of

where the CRBRP waste will be kept. Until the DEIS includes a proper analysis of the realities that must be dealt with in handling CRBRP wastes, the NRC will not have complied with NEPA's requirements for a full assessment of the project's impacts.

A most glaring omission from the Supplement's discussion of waste management is any mention of the NRC's ongoing "waste confidence" proceeding, a proceeding begun since issuance of the 1977 CRBRP FES. Equally distressing is the contradiction between the NRC staff's position on waste management in this Supplement and in the waste confidence proceeding. The waste confidence proceeding is the NRC's court-directed investigation to "assess generically the degree of assurance now available that radioactive waste can be safely disposed of, to determine when such disposal or off-site storage will be available, and to determine whether radioactive wastes can be safely stored on-site past the expiration of existing facility licenses until off-site disposal or storage is available." (NRC's Notice of Proposed Rulemaking, 44 Fed. Reg. 61373, PR 50, 51, October 25, 1979; these purposes were reiterated by NRC Chairman Palladino at the commencement of the January 11, 1982 oral argument (Tr. at 3).) By order of the NRC (January 16, 1982) the NRC staff has taken no position in the waste confidence proceeding on what conclusions the Commission should reach and instead has been restricted to summarizing the record and

identifying the issues. We are thus seriously concerned that the NRC asserts in that forum that its staff has taken no position while the staff's posture in the CRBRP Supplement is markedly different, summarily adopting DOE's position in the waste confidence proceeding that waste management is simply a routine matter of building some facilities and does not pose significant environmental, technical, or socioeconomic concerns.

Thousands of pages have been filed in its waste confidence proceeding, identifying dozens of major issues that are as yet unresolved and which could have major adverse impacts. Indeed, the NRC staff itself has pointed out in the waste confidence proceeding the significant uncertainties regarding waste management:

"However, as DOE has acknowledged in its position and cross-statements, additional engineering development work remains to be done before safe waste disposal can actually be achieved. To the extent that technology for safe waste disposal is not "off the shelf" an NRC confidence finding would be largely an expression of confidence that the DOE ongoing waste research and development program will produce the anticipated results in the years ahead. Until the program is completed, there necessarily remains a degree of uncertainty regarding whether DOE will find the answer to questions still open and whether those answers, when found, will turn out as hoped for. We believe it is unlikely that an intensive review of the data base as it now exists would reduce the uncertainty to an insignificant level. . . ." ("The Report of the Working Group on the Proposed Rulemaking on the Storage and Disposal of Nuclear Wastes," hereinafter cited as "NRC staff summary report," January 29, 1981, p. 7.)

Moreover, while the CRBRP Supplement does not mention any inadequacies of DOE's program, the NRC staff's summary report in the waste confidence proceeding in contrast states:

"In addition, the Working Group believes that the description of the DOE program is lacking in regard to an important element: a discussion which clearly delineates the linkages between technical projects and technical problems, the timing of expected solutions, and the integration of the solutions into the decision-making process. As an example, the discussion of in-situ tests (pages II-248 and II-268) describes a score of geotechnical tests underway at more than a dozen sites. What is lacking is a discussion of how these investigations are integrated into the logical sequence of site investigation activities and thence into site selection decisions." (Id., pp. 23-24.)

The Supplement does not even acknowledge the sharp dispute over the adequacy of DOE's waste management program and the conclusion of many that DOE's program is insufficient to assure that permanent, safe disposal of radioactive wastes, including those of the CRBRP, will be developed in the foreseeable future. (See, for example, "Consolidated Statement of the State Group," December 18, 1982, PR-50, 51; hereinafter cited as "States' Consolidated Statement," filed in the waste confidence proceeding on behalf of the California Energy Commission; California Department of Conservation; the Attorney General of the State of New York; Illinois; Massachusetts; Minnesota; Ohio; Wisconsin; Delaware; and Ocean County and Lower Alloways Creek Township, New Jersey.)

The CRBRP Supplement fails to mention that the scientific feasibility of isolating radioactive wastes from the biosphere for the extensive periods required to assure human safety has not been validated. (States' Consolidated Statement, p. 5.) It also fails to acknowledge the numerous gaps in present technical knowledge concerning permanent waste disposal which, if unresolved, could result in extremely adverse environmental impacts. As we pointed out in our comments on DOE's DEIS for the overall breeder reactor program, these technical gaps include:

- a. Hydrology--Little is known about water transport of radionuclides to the biosphere. (States' Consolidated Statement, p. 7.)
- b. Selection of geological mediums--None of the geological mediums under study have been shown to be technically capable of assuring safe isolation. Each medium under consideration is known to present serious, time-consuming, and possibly insurmountable problems. (Id., p. 8.)
- c. Waste rock interaction--There is no real understanding of the interaction of waste with host rock and therefore no assurance that the physical, chemical, and thermal effects induced by the presence of the waste will not cause unmanageable disruptions. (Id., p. 7.)

- d. Future climatic changes, shaft sealing and bore-hole plugging, monitoring, cannister degradation, waste form dissolution, reaction in the overpack region, rock mechanics, retrievability, seismic and tectonic activity, and waste packaging. (Id.) The Supplement addresses none of these problems.

The Supplement is also completely inadequate in its analysis of the institutional problems with developing adequate waste management facilities. The Supplement states that "the waste from the CRBRP would contribute only a small portion of the total capacity of such planned facilities; thus any socioeconomic impacts associated with CRBRP waste management would be a small increment to overall U.S. management socio-economic impacts. In addition, socio-economic effects of a geologic repository were assessed (DOE 1980b) and found not to be limiting in terms of cost/benefit balance." (Supplement, p. D-34). However, one of the most important studies on waste management, the Interagency Review Group Report, concluded that the resolution of social, political, and institutional concerns is necessary to permit the orderly implementation of a nuclear waste program and that "resolution of institutional issues may well be more difficult than finding solutions to remaining technical problems." (States' Consolidated Statement, pp. 13-14.) Clearly, the DEIS' cursory conclusion on socioeconomic impacts of CRBR wastes does not present the

analysis required by NEPA. Here again, the NRC staff dismissal of institutional problems, based upon the staff's summary reliance on DOE's assessment, contrasts markedly with its public position in the waste confidence proceeding.

The Supplement is also seriously inadequate in its blanket conclusion that as-yet unpublished Environmental Protection Agency environmental radiation protection standards will limit total repository impacts to insignificant levels. (Supplement, p. D-20.) Basically, the Supplement rationalizes that even though EPA has not issued its radiation criteria, and therefore there is no assurance that the impacts of CRBRP emissions will be insignificant or that the CRBRP will even meet the EPA standards, one can simply assume that there will be no problems. The status of the EPA standards and whether DOE's program will meet the standards are significant issues being debated in the NRC's waste confidence proceeding. (States' Consolidated Statement, p. 13.) The Supplement fails to mention this controversy. The environmental, site selection, and performance criteria for a repository, including the one that will handle CRBRP wastes, are still speculative, as is a demonstration that the criteria can be met. (States' Consolidated Statement, p. 38.)

The Supplement is also inadequate in its discussion of the actual sites that would be used for permanent disposal of CRBRP high-level radioactive waste. The Supplement does

not even identify the primary sites under consideration, even though they are well known--the Hanford Reservation, the Nevada Test site, and salt beds in Texas, Mississippi, Utah, and Louisiana--or the environmental impacts of storing wastes from CRBRP at those sites.

Finally, the discussion of spent fuel storage is almost nonexistent. In fact, the Supplement simply mentions that wastes may be indefinitely stored on-site rather than shipped for permanent burial. (Supplement, p. 3-14.) As with permanent waste disposal, significant questions have been raised in the NRC's waste confidence proceeding about the adequacy and safety of indefinite on-site storage. Certainly some discussion of the CRBRP on-site storage program, its risks, and impacts is required.

Had the Supplement properly assessed the numerous technical and institutional issues associated with properly handling the wastes from CRBRP, it could not have concluded that waste management will not have a significant impact and that the issues in waste management for CRBRP are limited to easily resolvable decisions over which final site to choose and to building the actual facilities. We therefore recommend that the Supplement be withdrawn until a proper assessment of this critical issue is performed.

CEC-5 Use of the "Table S-3 Rule"

The 1977 FES relied upon the NRC's "Table S-3 Rule" in preparing Table 2 and 3 of Appendix D. The NRC developed Table S-3 to provide a set of numerical values intended to reflect the environmental effects of the uranium fuel cycle. The United States Court of Appeals for the District of Columbia has held the Table S-3 Rules invalid because

"... they fail to allow for proper consideration of the uncertainties concerning the long-term isolation of high-level and transuranic wastes, and because they fail to allow for proper consideration of the health, socioeconomic and cumulative effects of fuel-cycle activities." (NRDC v. NRC, ___ F.2d ___, No. 744586, pp. 11-12 (D.C. Cir., Apr. 27, 1982).)

The NRC may still be basing its analysis upon this approach. (See, Supplement, Chapter 5, especially p. 5-18, and p. 11-27.)

CEC-6 The Supplement's Decommissioning Analysis is Inadequate

The Supplement's decommissioning analysis for the CRBRP is limited to a generic discussion of environmental impacts associated with decommissioning nuclear facilities generally. (Supplement, p. 10-4.) The discussion of alternatives, environmental impacts, and the cost-benefit analysis is inadequate since it contains essentially no analysis specifically related to decommissioning CRBRP. The reason for this problem is clear--the applicants' have not developed any definite plans for decommissioning the CRBRP. (Supplement, p. 10-4.)

We direct the NRC's attention to a recent General Accounting Office Report on decommissioning, "Cleaning Up Nuclear Facilities--An Agressive and Unified Federal Program is Needed," (GAO/EMD-82-40), May 25, 1982. After thoroughly analyzing federal programs for decommissioning, GAO has concluded:

"Selection of a tentative decommissioning method during the design of a nuclear facility is important if the owner of the facility, as well as Federal regulators, are to effectively plan for decommissioning. An early and precise as possible determination of the method will allow the facility to be designed to facilitate decommissioning, thus reducing cleanup costs and avoiding delays in decommissioning. Early selection will also enable Federal agencies and States to better estimate waste disposal requirements.

"Despite these benefits, Federal decommissioning programs in the past have not sufficiently considered and incorporated decommissioning needs during the facility planning and design phase . . ." (p. ii).

". . . GAO believes it important that the final policies under development, and any DOE actions, emphasize that

--a tentative decommissioning method be determined early on so that design features can be incorporated to expedite and simplify decommissioning (see p. 18) and

--a funding mechanism be established, based on the tentative method selected, at or before the start of operations to ensure that sufficient money is available to decommission the facility at the end of its useful life. (See p. 21.)" (pp. ii-iii.)

"Regardless of the decommissioning method used, it is important that the method be selected

SEC-6
early in the facility-planning process. By doing so, engineers can incorporate features in facility design which will facilitate decommissioning and reduce cleanup costs." (p. 19.)

"Early determination of the decommissioning method will also aid in estimating future waste volumes so that adequate disposal capacity will be available when needed. . . . [T]he volume of waste generated by decommissioning will vary depending on the cleanup method used. Since Federal agencies are uncertain about what decommissioning method will be used, they have not been able to estimate the future volumes of waste and when these wastes will be generated. The short-term impact of this situation is that reliable estimates of waste disposal site capacity needs cannot be made, and appropriate planning for waste disposal sites cannot be done. The potential long-term impact could be that waste disposal site capacity may not be available when needed--particularly for waste from commercial decommissioning activities." (p. 20.)

The Supplement fails to even mention this obviously relevant critique and that the NRC itself is developing a proposed policy that would require licensees to consider decommissioning needs at the time facilities are planned and designed. (GAO report, p. 21.) In order to meaningfully analyze CRBRP decommissioning impacts the NRC should require a specific decommissioning plan and then revise the Supplement to include an analysis of that plan and its impacts.

THE PENNSYLVANIA STATE UNIVERSITY

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WAL

College of Science
Department of Physics

Area Code 814

Director, Clinch River Breeder
Reactor Program Office
U.S. Nuclear Regulatory Commission
Washington, D.C.
20555

Dear Director:

Enclosed are my comments on the Draft Supplement No. 1 to the Final Environmental Statement related to construction and operation of the Clinch River Breeder Reactor Plant, NUREG-0139. Please note that the opinions and calculations presented here are my own, and not necessarily those of the Pennsylvania State University.

I hope that these comments are used in developing the Final Supplement. Would you also please send me a copy of that final Supplement when it is available.

Sincerely,

William A. Lochstet

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Environmental Impact of
CRBRP
by

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September 1982

The Nuclear Regulatory Commission has attempted to estimate health consequences of construction and operation of the Clinch River Breeder Reactor Plant (CRBRP) in its Environmental Statement (NUREG-0139) and its draft supplement No. 1 (Ref. 1). This draft statement is totally inadequate in several ways.

WAL-1

Section 7.1.3 states that the environmental risk of accidents from the CRBRP is "not significantly" different from current LWR. A casual examination of table A 8.1 indicates that this is not so. There are 7 plants listed as being presently operable , or operated in the USA. EBR-1 experienced a fuel melting of the ends of every fuel rod. Fermi also experienced a fuel melt accident. Thus two of seven have experienced a serious fuel melt accident. The history of LWR plants is not that accident ridden, although fuel was damaged at TMI -2, SL-1, Waltz Mills, as a few obvious examples from the USA experience. Thus the actuarial examination of the history will show that there is a significant difference in the risk from a fast breeder reactor and a LWR, in the USA.

WAL-2

A second area of omission is the environmental impact of the supporting fuel cycle. It is stated in section 5.7.2.7 (p 5-15) (Ref. 1) that the depleted uranium for the blanket will be obtained from DOE stockpiles at gaseous diffusion plants. Further, section D.2.1 (P. D-8) states that no impacts due to mining or milling of uranium are to be charged to the CRBRP, since these operations

* The information presented here does not necessarily reflect the position of the Pennsylvania State University, which affiliation is given here for identification purposes only.

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have already been incurred as a result of other fuel cycles (Ref. 1). This is at best wishful thinking. It changes the cost to benefit ratio of mining and milling, but does not eliminate it. In this case, the enriched uranium has a benefit of being reactor fuel, and the tailings have a benefit of CRBRP blanket fuel.

The CRBRP will require 11 MT of uranium (depleted) as input fuel at each of its annual refuelings (Fig. A5.1, Ref. 1). The plant lifetime is given as 30 years (Sec. D.2.2.4, Ref. 1), which implies 29 refuelings using a total of 319 MT of uranium. In addition the initial fuel loading contains 28.7 MT of depleted uranium (Table D.1, Ref. 1). This represents a total of 348 MT of uranium required. This must be mined and milled to be available as enrichment tails.

The total Plutonium necessary for the first core is 1.71 MT as given in Table D.1 (Ref. 1). At the end of the first year of operation, new fuel will be needed using 0.894 MT of Pu as given in Fig A5.1 (Ref. 1). This material must be ready to install, and cannot be obtained from the fuel just removed. Thus the initial plutonium requirement is 1.71 plus 0.894, or 2.6 MT of Pu. This material will be obtained from the defense program as per section D.2.1 (Ref. 1). Since the defense program plutonium will be very low in Pu-240, and the CRBRP plutonium will contain 12% to 20% Pu-240 as shown in table D.5 (Ref 1), the future production cannot be used to repay this defense program Pu. Thus the environmental cost of producing this original 2.6 MT of Pu is to be born by CRBRP. The production of 2.6 MT of Pu will require the mining and milling of at least 370 MT of uranium to feed the production reactors. Thus the total uranium required for CRBRP is 370 MT for Pu, plus 348 MT for tails for a total of 718 MT of mill output.

To obtain 718 MT of uranium mill output, would require an input of 748 MT for an average Mill operating at 96% recovery. Thus, about 30 MT of uranium would remain in the mill tailings.

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WAL-2 Also contained in the mill tailings will be 12,8 kilograms of thorium-230 which is in secular equilibrium with the 748 MT of U-238. This will decay to radon-222 as has been pointed out by Pohl (Ref. 2). The result will be a total of 1.9×10^9 Ci of radon will be generated with a time scale determined by the 80,000 year half life of thorium-230.

Furthermore, the 30 MT of uranium-238 in the mill tails will also decay to radon-222 thru several steps as has been described by the NRC in GESMO (Ref. 3). The result in this case will be a total of 4.3×10^{12} Curies of radon-222. Not all of the radon produced in a mill tailings pile escapes, because it may undergo decay before it gets to the atmosphere. At present, some recent tailings piles have two feet of earth cover. In this case, the EPA estimate is that 1/20 of the radon produced escapes to the air (Ref. 4). This factor will be used here, so that it is expected that a total of 2.1×10^{11} Ci of radon-222 will be released to the air as the U-238 decays.

Chapter IV of GESMO (Ref. 3) suggests a value of 1.7×10^{-6} deaths for each curie of radon-222 released from a typical mine/mill site in a western state. If this factor is applied to a release of 2.1×10^{11} Ci, the result is 360,000 deaths. This is one of the costs of the CRBRP.

The use of the full time for radioactive decay is required by the decision of the court at footnote 12 of NRDC v. USNRC, 547 F. 2nd 633 which states in part:

We note at the outset that this standard is misleading because the toxic life of the wastes under discussion far exceeds the life of the plant being licensed. The environmental effects to be considered are those flowing from reprocessing and passive storage for the full detoxification period.

Thus, the entire lifetime of these wastes must be considered as has been done here.

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The Draft document (Ref. 1) compares expected radiation exposure to natural background in several places (pp. 5-20, 10-3, table A10.2). In these instances it is shown that the radiation exposures are much ~~na~~ smaller than natural background. It is nowhere stated that the operation of CRBRP is going to eliminate background radiation. Background is not a benefit, nor a cost in this cost - benefit comparison. At best it is interesting and irrelevant. It must be shown that the benefits of plant operation are greater than the costs of operation. This is difficult to do, since they are not measurable in the same quantities. However, the benefits must be immense indeed to balance out the cost of this plant which exceeds 360,000 deaths. This is the comparison required by NEPA.

References

- 1 "Draft Supplement to Final Environmental Statement related to construction and operation of Clinch River Breeder Reactor Plant" NUREG-0139, Supplement No. 1, Draft, U.S.N.R.C., July 1982, Draft.
- 2 R.O. Pohl, "Health Effects of Radon-222 from Uranium Mining" Search, 7(5), 345-350 (August 1976).
- 3 "Final Generic Environmental Statement on the Use or Recycle Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors," NUREG-0002, U.S.N.R.C., August 1976
- 4 "Environmental Analysis of the Uranium Fuel Cycle, Part I - Fuel Supply" EPA-520/9-73-003-B, U.S. Environmental Protection Agency, October 1973

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